The Development of GIS Instructional Model to Facilitate Authentic Intellectual Work in Secondary Social Studies Classrooms in Kuwait

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Dissertation submitted to the faculty of the Virginia Polytechnic Institute and State University in partial fulfillment of the requirements for the degree of

Doctor of Philosophy

In

Curriculum & Instruction

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March 23, 2020

Blacksburg, Virginia

Keywords: Geographic Information System, Inquiry Design Model, Authentic Intellectual work

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ABSTRACT

The adoption of Geographic Information System (GIS) technology in social studies classroom practices has helped accelerate the achievement of educational goals. However, despite the value that GIS possesses for supporting student learning skills, few schools have adopted it so far. A reason for this deficiency lies in the absence of specific instructional models that demonstrate possible methods for incorporating GIS into class curriculum. This study sought to address this problem, tailored specifically for Kuwaiti social studies classrooms, with the design, development, and validation of a GIS Instructional Model to facilitate AIW. The study employed a design and development research methodology, comprised of five major phases, (i) selection of model components and theoretical foundation, (ii) analysis and development, (iii) formative feedback, (iv) revision, and (v) usability evaluation. In phase one, the Inquiry Design Model (IDM) format and components with AIW framework were selected to provide basic guidelines for the GIS Instructional Model. In phase two, following a comprehensive review of relevant academic literature, and in combination with personal experience, the researcher developed a preliminary GIS Instructional Model. In phase three, two expert reviewers evaluated the model, delivering their opinions by completing an online survey and taking part in follow-up interviews. The expert reviewers were primarily tasked with determining the model's ability to facilitate AIW in a social studies classroom, and providing suggestions for improving its performance. In phase four, the details gleaned from this formative feedback phase were then used to revise the model and enhance its effectiveness. In the last phase, six Kuwaiti expert reviewers assessed this updated version of the GIS Instructional Model to determine what barriers it might face regarding its implementation in the Kuwaiti educational system. They completed an online survey as part of this process and provided possible solutions to address perceived barriers. The data gained from expert reviewer feedback in these formative and usability evaluation phases were analyzed using qualitative methodologies. This step-by-step procedure helped to validate the model. As a result, a ready-to-implement teaching model, with all necessary teaching materials and instructions, was developed for Kuwaiti social studies classrooms. This model is proposed to enable social studies teachers to better understand how to integrate GIS into their classrooms to support AIW. Recommendations are provided for Kuwaiti educational policymakers and stakeholders to help overcome perceived obstacles that may hinder model implementation; suggestions for future research are also included.

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GENERAL AUDIENCE ABSTRACT

Geographical Information Systems (GIS) are software-based technologies which simplify the gathering, storing and manipulation of spatially-related data in ways which allow users to visually represent complex geographic phenomena more easily, bringing greater understanding for the world around us. As a result, the integration of GIS technology into social studies classroom practices has assisted student learning and achievement. However, despite the value which GIS possesses, few schools have integrated this technology so far. A significant reason for this limitation is the lack of clear guidelines or models which demonstrate how to employ this technology in the classroom. To help address the problem, this study developed a GIS Instructional Model for Kuwaiti social studies teachers to facilitate student authentic intellectual work, i.e. the student's demonstration of their deeper understanding for the knowledge and skills they are learning.

The study employed a design and developmental research methodology, comprised of five major phases, (i) selection of model components and theoretical foundation, (ii) analysis and development, (iii) formative feedback, (iv) revision, and (v) usability evaluation.

Phase one involved the selection of the study's theoretical foundation. In phase two, following a comprehensive review of relevant academic literature and, in combination with personal experience, the researcher developed a preliminary GIS Instructional Model. Two expert reviewers evaluated the model in phase three, delivering their opinions by completing an online survey and taking part in follow-up interviews. This feedback was analyzed in phase four, leading to revisions in the GIS Instructional Model to improve its quality for supporting student learning. In the final phase, six Kuwaiti expert reviewers assessed the newly-updated model to determine what barriers it might face regarding its implementation in the Kuwaiti educational system. They completed an online survey as part of this process and provided possible solutions to address these perceived obstacles. This step-by-step procedure helped to validate the model. The overall result was the development of a ready-to-implement teaching model, with all

necessary educational materials and instructions, for employing GIS technology in Kuwaiti social studies classrooms to support student authentic intellectual work. In addition, recommendations were provided for Kuwaiti educational policymakers and stakeholders to help overcome perceived obstacles that may hinder model implementation; suggestions for future research are also included.

DEDICATION

To my parents.

To my mother, Naeemah Saad Alhashan, and to my late father Salem Rashed Alazmi, who did not stay in this world long enough to see his daughter receive her doctorate. You may have left this world but you never left me.

To my husband.

To my beloved husband Abdulaziz Alsenafi

To my children.

To my wonderful children Hamad, Ahmed, Awrad, and Manar:

ACKNOWLEDGEMENTS

Foremost, I thank Allah the Merciful, who gave me the strength, patience, ability and opportunity to undertake this research study and to persevere and complete it successfully. Without his blessings, this achievement would not have been possible - the most merciful Alhamdulillah.

I was not alone on my journey to complete this dissertation. Many individuals supported me along the way, and it is my pleasure to acknowledge them here. Sincere gratitude goes to my dissertation committee. I would especially like to express deep appreciation to my adviser (committee chair) Dr. David Hicks, who provided encouragement and academic advice to keep me on track. His support helped me during the entire period of research and writing of this dissertation. Without his guidance and persistent help, this dissertation would not have been possible. Besides my adviser, I would also like to thank the rest of my committee, Dr. Bonnie Billingsley, Dr. Thomas Williams, and Dr. Melissa Lisanti, for their advice, encouragement, and comments which encouraged me to broaden my research from various perspectives. They attended each meeting with positive attitudes, offering support and insightful comments. I always felt my committee wanted me to find success.

Very special gratitude goes to my mother Naeemah Saad Alhashan, and to my late father Salem Rashed Alazmi, who have provided me with moral and emotional support my entire life. By the grace of God, I grew up with wonderful parents who taught me the value of education, hard work and the desire to always be a learner. No words of thanks could ever repay your dedication in teaching me; I am more grateful than I can ever express.

To my beloved husband Abdulaziz Eid Alsenafi- your unending support, with unconditional love, at every step of this journey is an inspiration. Thank you for helping me to achieve my life-long dream. You give me courage to never give up. Thank you for supporting me through everything, and especially for your patience and encouragement throughout this experience.

Many thanks to my beloved children Hamad, Ahmad, Awrad, and Manar. While you may not fully understand what “PhD” means, you always accepted my constant need to read, study and research to reach this milestone. It is my fervent hope that my example will inspire you to never stop learning, to set lofty goals for yourselves - and to persevere - no matter the obstacle. I will be forever grateful. To my sisters and borothers, thank you for your love and support through this journey.

And finally, last but by no means least, is special thanks to my close friend and colleague Dr. Ayeshah Alazmi; I will be forever grateful for your words of encouragement, academic discussions, and joyful moments. Many thanks also goes to my close friend and colleague Asmaa Alazmi for emotional support, help, and encouragement. To all my friends in Blacksburg who supported my determination and filled my life with joy, especially when I felt homesickness, I give my sincere gratitude for being there when I needed the extra strength to help me fulfill my dream of completing my PhD.

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LIST OF ABBREVIATION

AIW	Authentic Intellectual Work
ESRI	Environmental Systems Research Institute
GIS	Geographic Information System
IDM	Inquiry Design Model
MoE	Ministry of Education
NCGE	National Council for Geographic Education
NCSS	National Council for Social Studies

CHAPTER 1
INTRODUCTION

> The emergence of GIS has revolutionized the way people explore and understand the world around them. The ability to capture, manage, analyze, and display geographic data and information has enabled GIS users to make decisions and solve problems as diverse as designing routes for buses, locating new businesses, responding to emergencies, and researching climate change. Each of these decision-making and problem-solving applications of GIS has the common focus on investigating the "whys-of-where."
>
> Milson, Demirci and Kerski, 2012, p.3

A Geographic Information System, or GIS, is a geographical mapping process designed to store, analyze, synthesize, and display spatial data. Its primary purpose is to create an interactive, visual interpretation of these data that allows users to solve present-day problems in ways not previously practical via more traditional topographic interpretations. More specifically, GIS enables users to look at patterns, characteristics, and trends to discover the hidden relationships between these phenomena and the physical locations where they occur, thus allowing a more sophisticated view of the data as a whole. And as the Environmental Systems Research Institute (ESRI) (2017) concludes, GIS has proven beneficial to explaining, predicting, and planning strategies that tackle complex, real-world issues. It is therefore no surprise that a wide range of public and private institutions around the world consider this technology to be a valuable decision-making tool.

As an example of some situations where GIS already plays a useful role, a number of institutions now apply the technology to help determine the best locations for hospitals, schools, transportation networks, etc. GIS is also used to analyze urban growth and plan for optimal expansion (Subasinghe, Estoque & Murayama, 2016). Additionally, to help prepare for/limit storm damage, some users rely upon GIS disaster management tools to identify flood-prone streets (Longley, Goodchild, Maguire & Rhind, 2015). They apply similar methods in anticipation of earthquakes and other natural catastrophes. GIS can also model the spread of diseases in order to more effectively monitor and control them, even on a global scale (Glass, Aron, Ellis & Yoon, 1993). In other words, using GIS technology to visualize geographical data helps users, across myriad platforms and disciplines, to better address the problems they are evaluating from a spatial perspective. However, it is the benefit which GIS holds for improving education programs that this dissertation will center upon.

In K-12 education, for instance, Goodchild and Kemp (1990) were among the first to argue for the integration of GIS in secondary schools. They indicated that the availability of data, and the benefits of GIS to student learning, would offer the greatest potential gains in preparing students for their future and civic life. As a result, educators began using GIS as an instructional tool in secondary schools, especially in social studies classrooms, from 1999 onwards (Milson et al, 2012). Many studies found that GIS technology has the potential to promote higher-order thinking and stimulate student interest in solving real-world problems (See Barstow, 1994; Bunin, Esposito, Duke, & Palmer, 2017; Goodchild & Kemp, 1990 & National Research & Geographical Sciences Committee, 2005). GIS is one of the technological tool that helps to achieve the National Council for Social Studies [NCSS] standards and vision. It helps students to solve problems and make informed decision that will prepare them to college, career, and civic life (C3). The NCSS (2013) believes that:

> Students need the intellectual power to recognize societal problems; ask good questions and develop robust investigations into them; consider possible solutions and consequences; separate evidence-based claims from parochial opinions; and communicate and act upon what they learn. And most importantly, they must possess the capability and commitment to repeat that process as long as is necessary. Young people need strong tools for, and methods of, clear and disciplined thinking in order to traverse successfully the worlds of college, career, and civic life. (p. 6).

Another credible advantage to implementing GIS in social studies classrooms is its potential to facilitate disciplined inquiry which, in light of the new C3 framework, speaks to the, "…heart of social studies instruction," (NCSS, 2017, p. 8). Across literature, many studies indicated the power of GIS in facilitating disciplined inquiry (Favier, van der Schee, & Scholten, 2012; Huynh Sharpe, Charman, Tong & Greensmith, 2012; Kinniburgh, 2012). The GIS helps to achieve the four dimensions of C3 framework that focuses on (a) plan inquiries and develop questions; (b) apply concepts and tools; (c) gather sources and use evidence; and (d) draw well considered and defended conclusions from which to take appropriate action. Students work with GIS to formulate their questions, make investigations, and apply knowledge and skills to solve real-world problems or make informed action. For example, in Australia, students used GIS to investigate coastal erosion problems, and potential management strategies (Kinniburgh, 2012). In this study, students first determined the research project questions, collected data, entered the data into the ArcGIS program and used effective spatial analysis tools in ArcGIS to solve the erosion problem. This example clarified how students used GIS as inquiry tool to explore real-world problems.

The powerful and authentic social studies emphasis on integration Authentic Intellectual Work (AIW) framework to create an inquiry-based learning environment (Newmann, Carmichael, & King, 2015). Many studies support the value of digital technologies (e.g. GIS) to engage students in AIW (see Hicks, Doolittle & Lee, 2004; Doolittle & Hicks, 2003; Newmann, et al., 2015). AIW challenges students, via projects and units of instruction, students performing disciplined inquiry to (a) construct their knowledge; (b) make real-world applications of that knowledge; and (c) understand the value of this learning beyond school (Newmann et al., 2015). Furthermore, using GIS technology in the classroom could have broader potential that sustains AIW. Students could use it as an exploratory tool to increase their knowledge by applying it to projects that have relevance to their own lives and experiences.

Moreover, Despite the value of GIS technology to support students learning, very few schools have adopted it so far (Hong & Melville, 2018; Kerski, 2003; Lam, Lai, & Wong 2009; Millsaps & Harrington 2017; Milson et al, 2012). Indeed, Kerski (2003) indicates that less than 2 percent of American high schools have adopted GIS. Similarly, Milson et al. (2012) note that out of 33 countries studied, only eight embedded GIS in official secondary school curriculum: China, Finland, India, Norway, South Africa, Taiwan, Turkey, and the United Kingdom. In my home country of Kuwait, I would also contend that GIS is poorly used in social studies classrooms. Typically, teachers explain GIS theoretically, but do not apply it practically to demonstrate how it actually works. Put more simply; students learn *about* GIS, but not *with* GIS.

There are several reasons behind the limited implementation of GIS in high schools and they include: (a) the duration and cost of incorporating the system in curricula; (b) limited infrastructural resources; (c) inadequate teacher preparedness; and (d) insufficient faculty and administrative awareness about the value of GIS (Milson et al., 2012). Interestingly, many researchers argue that there is a lack of compelling, localized, and context-specific instructional models for demonstrating GIS potential, or ways to merge it within curricula (Hong & Melville, 2018; Kerski, 2003; Lam et al., 2009; Millsaps & Harrington 2017; Milson et al, 2012). Kerski (2003) contends this deficiency may well be responsible for the sporadic use and slow uptake of GIS in classroom studies.

Problem Statement

Many studies have indicated that the power of social studies instruction involves facilitating student-centered learning (King, Newmann, & Carmichael, 2009; Milson et al., 2012; NCSS, 2016). However, King (2016) noted that, despite many curriculum reforms made around the world to improve instruction, the traditional approach remains strong. Traditional instruction is a teacher-centered technique in which the teacher serves as the primary source of information delivered to students (Rogers & Frieberg, 1994). Fielding (2005) noted that most social studies instruction has focused upon this method which emphasizes the memorization of large amounts of text, rather than students having to employ critical thinking skills. As a result, students became passive learners; they receive information, but are only required to recall it - rather than demonstrate understanding (Freiberg, 1999).

That being said, a major goal for social studies instruction is to facilitate student-centered learning through, "…the promotion of civic competence - the knowledge, intellectual processes, and democratic dispositions required of students to be active and engaged participants in public life" (NCSS, 2010, p. 9). To help students become civically competent, social studies instruction should encourage them to become inquiring - to actively think for themselves. Facilitating inquiry requires students to engage their critical thinking skills by having to solve real-world problems or make informed decisions instead of just recalling content (NCSS, 1993). Indeed, educational research within the field of social studies has focused upon precisely this; the importance of facilitating inquiry to improve student learning outcomes (ESRI, 2003; Grant, Swan, & Lee, 2017; NCSS, 2017). However, Grant et al., (2017) have indicated that despite this research indicating the importance of inquiry, very few empirical studies have actually addressed the *performing* of inquiry in social studies classrooms. There is a significant gap, therefore, between research and practice. This study aims to help redress that issue.

Social studies instruction must be intellectually challenging for students, enhancing their level of thought in an effort to build upon their knowledge by facilitating inquiry. The AIW framework (King et al., 2009) reflects the most effective method for teaching and learning social studies content. This framework is designed to prepare students for lifelong intellectual demands.

It is achieved by encouraging students to engage in rigorous endeavor, developing their capacity for in-depth understanding, and raising their interest in academic work itself. AIW's three main criteria are: (a) construction of knowledge, (b) disciplined inquiry, and (c) value beyond school. These three tenets provide the foundation for the student's intellectual work necessary for social, professional and civic success (King et al., 2009). In brief, the AIW framework implies that, when conducting their disciplined inquiry, students should work collaboratively, engage in discussion, communicate with others, and using critical thinking skills to construct deep knowledge which will enable them to productively address topics that are relevant to their lives and/or the world around them.

Many studies have demonstrated the strength which GIS possesses for facilitating geographic inquiry, critical thinking skills, and collaborative work (Baker, 2002; Eksteen, Pretorius & Breetzke, 2012; Favier et al., 2012; Huynh et al., 2012; Kinniburgh, 2012; Liu, Tan & Xiang, 2012). Clearly, GIS can align with essential AIW framework principles; serving as a tool for achieving optimal student learning outcomes. As an example, ESRI (2003) noted that using GIS for conducting inquiry can promote ways of understanding, "…where something is, how its location influences its characteristics, and how its location influences relationships with other phenomena," (p.1). Furthermore, ESRI also noted that using GIS encourages students to follow the steps of geographic inquiry, "…[to] ask geographic questions, acquire geographic resources, explore geographic data, analyze geographic information and act upon geographic knowledge," (ESRI, 2003, p.1). Using GIS as a geographic inquiry tool encourages spatial analysis of data. Simply put, this interaction with visual representations of these data can provide students with new and deeper ways of understanding the phenomena involved. Thus, GIS has the power to facilitate AIW criteria and principles that will help to prepare students for their lifelong intellectual demands.

Although several case studies have provided insight into the potential significance of using GIS to facilitate geographic inquiry, promote critical thinking skills, and encourage collaborative work in social studies instruction (Kinniburgh, 2012; Liu et al., 2012), very few schools have adopted it (Milson et al., 2012). For example, just 2% of schools in the US had integrated GIS into their classrooms (Kerski, 2003). Although an older study, Kerski (2003) indicated that this deficiency was due to the lack of guidelines, or principles that clarify the power which GIS possesses, nor methods for how to implement it. He indicated that many social studies teachers lack knowledge about GIS technology, and have no clear idea for how to integrate it into their instruction practices.

This study attempts to bridge this gap in the literature by creating a theoretically-grounded, GIS Instructional Model that explains how to integrate GIS into classroom practices to improve student AIW. It will design, develop, and validate a teaching model that engages students in working with GIS to answer inquiries that follow six AIW criteria: (a) construction of knowledge; (b) deep knowledge; (c) critical thinking skills; (d) elaborated communication; (e) discussion and conversation; and (f) value beyond school. However, the model does not focus solely upon integrating GIS into the classroom, it also provides practical guidelines and examples for how to do so effectively, while still following the theoretical framework.

Research Purpose and Questions

The present study builds upon existing efforts that focused upon the importance of integrating GIS into social studies classes, and the technology's potential to promote student knowledge and skills. The study's purpose is to design, develop, and validate a GIS Instructional Model to facilitate AIW in social studies classrooms. To this end, the researcher developed a theoretically-grounded GIS Instructional Model for social studies teachers. The GIS Instructional Model features a short series of lessons that follow an Inquiry Design Model (IDM) blueprint. These lessons focus upon engaging students, working with GIS, to answer inquiries which facilitate the following AIW criteria: (a) construction of knowledge; (b) deep knowledge; (c) critical-thinking skills; (d) elaborated communication; (e) discussion and conversations; and (f) value beyond school. The developed model will be ready to implement within the grade 12 geography subject in Kuwait. The following research questions guided the study:

RQ1: How can a GIS Instructional Model be designed, from a pedagogical standpoint, to facilitate social studies inquiry and Authentic Intellectual Work?

RQ2: What barriers exist for integrating this GIS Instructional Model into Kuwaiti social studies classrooms, and can anything be done to mitigate these obstacles?

Organization of the Study

This study is divided into six chapters. Chapter 1 establishes its basis and relevance by providing a clear statement of the problems to be addressed and the reasons for doing so. Chapter 2 offers an extensive review of the relevant academic literature. It also explores the theoretical foundation for the GIS Instructional Model developed in this study. Chapter 3 discusses the methodology used to conduct the study. It also features descriptions of: (a) the research design; (b) developmental study procedures that clarify data collection and analysis, and how participants were chosen, and; (c) the quality of the research.

Chapter 4 presents the final GIS Instructional Model that resulted from the formative evaluation phase (See Ch.5), with brief descriptions regarding changes made to the initial version of the model (See Appx. G). From a structural perspective, I felt that presenting the information in a more traditional, temporally linear fashion might have been a distraction from the finished product. This is why I decided to place the final version of the model in Chapter 4; it forms the meat of this study's primary goal, to develop and validate a GIS Instructional Model. Reviewing the final version of the model achieves this aim and helps to answer the first research question, "How can a GIS Instructional Model be designed, from a pedagogical standpoint, to facilitate social studies inquiry and Authentic Intellectual Work?" Readers should be able to form a complete idea for what the model comprises and what it aims to achieve. There are also brief mentions for how the model differs from the original version (added elements are identified with an asterisk (*), while revisions are footnoted). The first part of Chapter 5 presents the reasons why these changes occurred.

Chapter 5 presents the two phases of the Expert Reviewer process. The first phase involved two U.S.-based experts. As can be inferred from the previous paragraph, their formative evaluation of the original version of the GIS Instructional Model allowed the researcher to revise the model to improve its quality. Their evaluation is presented in significant detail, along with suggested changes to the model, the reasons for doing so, and how they were effectuated. The second phase of the expert review process involved the usability evaluation process. Six Kuwaiti experts reviewed the final version of the GIS Instructional Model to identify potential barriers that may hinder its implementation in Kuwait, along with potential avenues for overcoming said barriers. In summary, the US Expert Reviewer feedback helped to validate the GIS Instructional Model in its present form (See Ch.4), while the Kuwaiti Expert Reviewer feedback helped to answer the second research question, "What barriers exist for integrating this GIS Instructional Model into Kuwaiti social studies classrooms, and can anything be done to mitigate these obstacles?" And finally, Chapter 6 provides a study summary and concludes with descriptions of its contributions, limitations, and potential future direction.

CHAPTER 2
A LITERATURE REVIEW

This literature review provides a comprehensive background on GIS, their implications, and potential ability to support the teaching of geography and social studies in secondary schools. The chapter has been divided into four main sections: (1) geography is a core component of social studies, (2) the context of geography in secondary social studies curriculum in Kuwait, (3) GIS in social studies curriculum, and (4) the theoretical framework. Since GIS is a geographical tool, I begin first by reviewing the literature concerning geography as a core ingredient within social studies education. I examine and clarify the relationship between these two disciplines. Next, in the second section, I provide an overview of the secondary social studies education in Kuwaiti schools. I start to address the structure of education system in Kuwait, and the place of secondary social studies and geography curriculum with Kuwaiti schools system. In the third section, I provide an overview of GIS and explain its components and importance. After this, the discussion turns to the potential and challenges of the use of GIS in social studies classwork. In the fourth section, I outline the theoretical framework of AIW, which acts as a guide my research.

Geography is a Core Component of Social Studies

To begin this analysis, we must first properly define the fields of geography and geography education. We will then address the place geography holds in social studies curriculum.

Geography

Simply put, geography is the investigation of the space and places that form our world. Places are located in a particular position or area of space on our globe; areas with common features are known as regions. These features may be natural (physical geography - such as climate, wildlife, terrain, etc.) or human (human geography - language, culture, religion, etc.). Geography has always focused upon the relationships between these features and space. It helps to answer questions about why some places have particular physical or human characteristics, how these characteristics are changing within time and space - and why they are changing (Maude, 2010). According to Maude (2010), geographers usually consider three analytical perspectives in their investigations: (a) place; (b) environment; and (c) space. With respect to places, geographers focus upon their uniqueness, such as what similar locations have unique features. They then compare the characteristics of these places to see how climate, relative location or culture, etc. affect them. When it comes to the environmental perspective, geographers study the relationships between people and their particular environment. And finally, regarding space, geographers study the spatial distributions of specific phenomena, their patterns, and the variations from one place to another.

Geography Education

Geography instruction reacts to student curiosity about the world around us, and its many varied characteristics. Through their study of geography, students should develop geographical reasoning skills which will enable them to better understand our world, strengthening their sense of global citizenship and responsibility for their own environment; this is geography's major contribution to education (NCSS, 2013). For example, when students explore a specific environmental issue, they will define the problem, analyze its causes and effects, and then suggest options for mitigation. In this situation, students not only develop their intellectual skills, but should also come to care for their environment and appreciate living in it safely. Geography education therefore provides students with both intellectual skills and empathy, which should enable them to make informed decisions to safeguard their environment. Along these lines, the NCSS (2013), states:

> Geographic knowledge helps people to make decisions about, “Where can I be safe, successful, and happy in my daily activities?” and “How can my community create and sustain a healthy environment?” Such knowledge is critically important to understanding what activities might be harmful to a place or what hazards might be encountered there. (p.40).

Moreover, while geography helps to improve a student’s global knowledge, it also increases their local understanding too (Bonnett, 2008). Geography teaches students about the world, how it is changing, and the effects these changes may bring to their own country. For example, students learn about global issues - such as migration, water shortage or climate change - and how these issues can impact their own lives. Students also learn about other places and countries, gaining understanding for the associated cultures and historical events. Thinking in terms of place also leads to a deeper understanding for the relationships between space and time, and between people and their environment (Hinde, 2015). Furthermore, students make connections; they compare the characteristics of their own location with those from further afield to gain understanding for how their own country is connected or differs from another. It gives students insight for how to see their country in a much wider context. Maude (2010) indicated that this type of knowledge improves student spatial thinking skills, enabling them to see spatial patterns, and investigate the relationships between object and space. And a spatial perspective of phenomena allows students to better understand the characteristics of a particular environment, population, place, etc.

Furthermore, geography teaching helps improve understanding for identity (Maude, 2010; Wasta, 2010). It also reveals how students understand places, the meanings they add to them, and how their identity and culture is formed by this investigation. Wasta (2010) adds to this, noting that geography teaching encourages an awareness of how places shape people's lives and provides students with a greater sense of self, as well as better acceptance for diversity. Having a good sense of personal identity, while also accepting diversity, leads to a student's improved social competence (De Miguel Gonzalez & Donert, 2014; Maude, 2010). Developing a student's understanding for their locality and community, also promotes their social competence. This is critical for preparing informed citizens.

In summary, geography's contribution to a school's education curriculum centers upon teaching students essential knowledge about their own place within the world at large. This equips them with a wide range of critical skills for understanding their world and acting responsibly within it. Geography teaching is uniquely placed to provide these skills in the proper context, and without this forum for acquiring such experience, there would likely be a gap in a student's understanding, knowledge, and skills that would otherwise prove much harder to bridge.

The Place of Geography in Social Studies Curriculum

Social studies is considered a major academic disciplinary subject within the educational curriculum from primary through secondary school (NCSS, 2013). It serves as an interdisciplinary umbrella that covers a variety of subjects in the social sciences, such as history, civics, geography, economics, political science, sociology, psychology, and anthropology. The C3 framework states that geography, civics, economics, and history are the core subjects that should comprise the foundation of all social studies courses (NCSS, 2013). These subjects are necessarily interconnected and frequently overlap.

Indeed, there are many references in scientific discourse that describe the interconnectedness between social studies and geography (e.g. Kerski, 2003; Nagel, 2016). Geography and social studies are bound together strongly, because geography is the study of people, environment, culture, and trade on local or global scales - all of which form a fundamental part of social studies education (Kerski, 2003). The Royal Geographical Society (2017) furthers this reasoning by explaining geography instruction's unique role as, "…bridging the social sciences (human geography) with the natural sciences (physical geography)." (Para. 1). Another source links the two disciplines by relating how geography is becoming an increasingly important aspect of understanding effective citizenship in a democratic society (Henau & Miguet, 2003). The NCSS (1993) characterizes social studies as, "…the integrated study of social sciences and humanities to promote civic competence." (P. 9). A primary goal of social studies education is to prepare students with the essential knowledge and skills they need to successfully navigate college, their career and civic life; geography contributes towards this end. As discussed earlier, geography helps to increase a student's sense of identity, their global awareness, and acceptance of diversity - these in turn help to promote their social and civic competence. Therefore, it is effectively impossible to separate geography from social studies curricula.

The practice of teaching geography and social studies varies between country (DaSilva & Kvasnak, 2011). For example, many U.S. and Canadian primary and middle schools merge geography instruction with history curricula and other human sciences. By secondary school, however, geography is an optional course, at best (Kerski, 2003; Mansfield, 2005). But within the United Kingdom, geography is taught as a separate subject (Catling, 1999). The following section describes how social studies and geography are taught in Kuwait.

The Context of Geography in Secondary Social Studies Curriculum in Kuwait

This section describes Kuwait's education system and offers details about how social studies and geography subjects are taught throughout the nation. To begin this analysis, we must first properly provide an overview of the structure of Kuwait's education system and clarify the position of secondary level within this system. We will then address the place that geography holds in the secondary social studies curriculum in Kuwait.

The Structure of Education System in Kuwait

In 2005/2006, the education system in Kuwait changed from 4-4-4 years to 5-4-3 years at successive educational levels, i.e. primary, intermediate and secondary. Currently, the general education system in Kuwait is divided into four levels: kindergarten (2 years), primary (5 years), intermediate (4 years), and secondary (3 years). Figure 1 illustrates this structure.

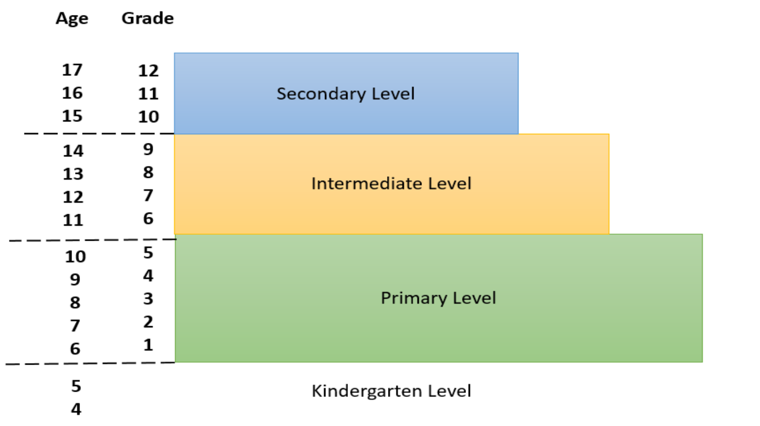

Figure 1. The Kuwaiti education system structure.

As Figure 1 depicts, kindergarten is not compulsory, but is free for all Kuwaiti citizens. The entry age is 4 years old, and the program takes two years. Primary education lasts five years, from grade 1 to grade 5. Primary education in Kuwait is compulsory, and students are admitted at age 6 years of age. The intermediate level lasts four years, from grade 6 to grade 9. Intermediate education in Kuwait is compulsory, and students who successfully complete this level receive the intermediate school certificate. Secondary school covers grades 10 through 12, with students between 15 and 18 years old. In their initial year of secondary school, students study the same subjects. However, following the first year, they have to choose one of two distinct education streams: science or the arts. In the final year, students who pass the final exam are awarded the secondary school certificate.

The Place of Geography in Secondary Social Studies Curriculum

The main objective of secondary school education in Kuwait is to provide students with the essential knowledge and skills they will need for college, their careers, and practical life. The latter is emphasized by World Data on Education (2010), which indicated that secondary school education should improve a student’s civic duty by developing understanding for their rights and obligations. It should also build a bridge between school, society, and the world around them. To achieve this aim, Kuwaiti schools teach several subjects to improve student skills and knowledge for future life; social studies instruction plays a major role towards this end, being in the national curriculum from primary school through the secondary level.

Indeed, Kuwait has long considered social studies as a primary vehicle for preparing future citizens for their civic duty. It provides students with an opportunity to learn about their country, and the world itself. The Ministry of Education (MoE) (2017) noted that social studies education plays an important role in achieving a major secondary school educational goal - that of preparing informed citizens. It helps equip students with important critical thinking skills, such as problem solving and making informed decisions, which will prepare them for a productive civic life, college, and career (MoE, 2017). Moreover, the social studies framework in Kuwaiti secondary schools encourages teachers to integrate technology to support the learning environment and achieve optimal scholastic outcomes (MoE, 2017).

Table 1 presents the social studies subjects as taught in Kuwaiti secondary schools, and reveals how the subject of geography is weighted within the set of social studies subjects. In secondary schools, social studies is divided into six subjects: history, geography, civics, sociology, physiology, and philosophy. In grade 10, all students study Kuwait’s history. In grade 11, arts stream students study history, geography and sociology, while those in the science stream take no social studies courses at all. In grade 12, art stream students study history, geography, psychology, philosophy, and civics, while those in the science stream study civics. However, grade 11 and 12 students, from both streams, have the option of taking an elective course in psychological health.

Teaching geography in the Kuwaiti social studies curriculum varies depending upon the education level. For example, in primary and middle schools, studying geography is a mandatory, though integrated subject; it is combined with history and other human sciences. But by secondary school, geography is taught as a separate subject in the arts stream - a key subject within their social studies curricula. Indeed, geography is taught as a separate subject three times per week throughout the academic year in grades 11 and 12 (for arts stream students). In grade 11, students learn about basics of geography, while in grade 12, they learn about contemporary global issues.

Table 1

Social Studies Subjects in Public Secondary Schools in Kuwait

Social Studies Subject	Times/Week	Grade 10	Grade 11		Grade 12	
			Science	Literacy	Science	Literacy
Kuwait History	3	√				
Geography	3			√		√
History	3			√		√
Constitution of Kuwait (civic)	1				√	√
Sociology	2			√		
Psychology	2					√
Philosophy	2					√
Psychological Health	1	Elective Course				

GIS in Social Studies Curriculum

This section describes the use of GIS in secondary social studies education, focusing on five topics: (a) an overview of GIS, (b) the relationship between GIS and social studies education, and (c) the role of ESRI in facilitating the use of GIS in social studies classrooms, (d) the potential of using GIS in social studies classrooms, and (e) the challenges of using GIS in social studies classrooms. The first topic defines GIS, and provides an overview of its importance, components, and process. It helps understand what the GIS is and how it works. The second section addresses the relationship between GIS and social studies education to understand how GIS is related to social studies, and the affordability of GIS in teaching the social studies discipline. The third topic describes the role of ESRI in facilitating the use of GIS into social studies classroom. The fourth topic discusses the potential of the integration of GIS into secondary social studies education. The fifth topic addresses what the challenges that may hinder the integration of GIS into social studies classrooms.

An Overview of GIS

As mentioned in Chapter 1, GIS is a computer system designed to capture, store, manipulate, analyze, and present geographical data for users' needs and purposes (ESRI, 2017; Jardine & Teodorescu, 2003). It is a powerful technology that has a system memory capable of handling vast and varied data sets which, after processing, permit users to obtain a visual interpretation of these data. GIS helps users to understand and relate to the what, when, how, and why of the world by identifying the *where*. A GIS, once properly set up, will translate sets of raw data into a display of spatial information which can then reveal trends, patterns and relationships between variables or distinct phenomena. This in turn can provide users with answers to questions that help them make decisions or solve problems.

GIS assists the decision-making processes in many scientific disciplines, including urban planning, geology, medicine, geography, and engineering, to name but a few. GIS technology can analyze urban growth, for instance, and help determine the most suitable locations for future expansion (Subasinghe et al., 2016). It can also predict the best locations for roads, highways, and airports (ESRI, 2017). In a related field, GIS can also help planners avoid building in flood-prone areas by using natural disaster tools (Longley et al., 2015). GIS helps geologists create soil mapping by soil classification or type (Kawy & Belal, 2013). Epidemiologists use GIS to conduct spatial analyses of global disease distribution for monitor and control (Glass et al., 1993). On a broader scale, the general public frequently finds GIS at work in their daily lives, whether with GPS devices, for example, Google Earth, or geotagging cell phone images when they travel. Quite simply, GIS is everywhere!

It is therefore useful to understand how GIS works as a technological tool to build multi-layer maps which meet the needs of those employing it. According to ESRI (2017) there are five main components to a GIS: Hardware, Software, Data, People, and Method as presented in figure 2. Hardware refers to the physical computer components which host the software, process the data, and display the results. Software is the user-interactive programming application which runs on the computer and analyzes the data for display. Data, whether it is spatial (maps), descriptive, or statistical in nature, is the key ingredient for the hardware and software to process into individualized GIS maps. Technical specialists (i.e. People) who have relevant knowledge and experience in the field under study, are also vital to the successful implementation of any particular GIS. Finally, a well-organized plan (i.e. a Method) is needed to achieve the objectives of a GIS. It is only through the skilled integration of the five components listed above that GIS operators will receive the full advantages of this technological tool.

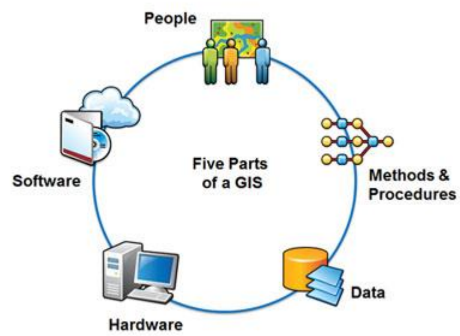

Figure 2. The GIS components (ESRI, 2012).

For GIS to solve problems or help its users make informed decisions, five main steps must be followed to achieve successful results: Ask, Acquire, Examine, Analyze, and Act (ESRI, 2017). Figure 3 shows the process of applying GIS to solving problems which require a geographic decision. In the first step, the user needs to properly define the problem which they require GIS analysis to solve. Framing the problem in the form of a question helps to determine the required analytical process to follow and how to present the data. Next, the user must select the type of data they need to acquire, and the methods for collecting it, such as interviews, statistics, or surveys. Then the user examines the data to ascertain whether it is appropriate for study. In the fourth step, the user analyzes the data with GIS tools. And finally, the user presents the processed data in whichever ways are the most informative, such as tables, graphs, or maps. Using this step-by-step process helps users evaluate problems and develop solutions.

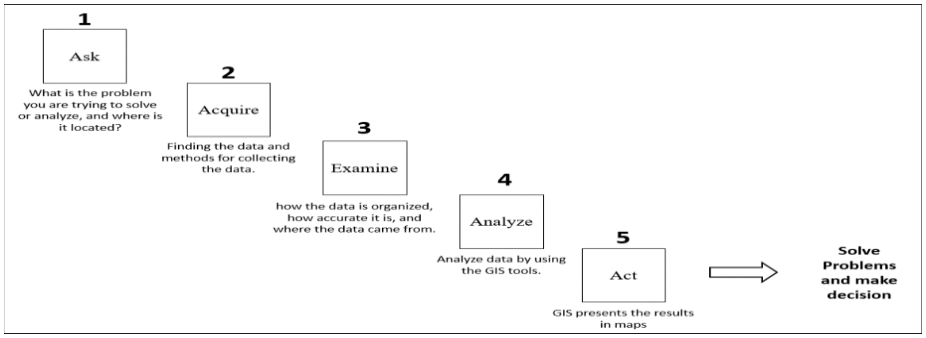

Figure 3. The process of applying GIS to solve problems (ESRI, 2013).

Creating GIS maps stimulates exploration of the spatial relationships within the raw data, and therefore helps the formulation of hypotheses for further evaluation or suggests new avenues to explore. Perhaps the most beneficial function of GIS is that "of associating, or attaching, attribute data to a spatially referenced base map" (Jardine & Teodorescu, 2003, p.6). This allows users to visualize multiple layers of geographic data to reveal relationships, patterns, and trends, which can then help answer real-world questions.

The Relationship Between GIS and Social Studies Education

As mentioned earlier in this chapter, geography is the study of places, people, and environment. For example, geographers study the ways people interact with their environment, and how this differs from place-to-place. They explore specific phenomena and their distribution across the globe; thereby generating understanding for the relationships between these phenomena and the spaces where they exist. Geography seeks to understand where some characteristics are found, why they are there, and how these characteristics change and develop over time. Geographers always classify the world by region in order to break down some of its complexity for better understanding. But this is an intensely difficult task, so there is an imperative need for new tools to help improve our ability to clarify and adapt to change.

With the dramatic rise in computing power and sophisticated software applications during recent decades, many new techniques have emerged to help a geographer better understand the world. The GIS, is one of the most effective tools, providing geographers with a visual representation of phenomena in the world. It also includes analytical operations for investigating the relationships between phenomena and the locations where they exist (or don't). This technological advance in the field of geography also reflects potential benefits for teaching geography and social studies in secondary schools. Indeed, many studies have argued for the integration of GIS technology into social studies curricula to support student learning (Hong & Melville, 2018; Kerski, 2003; Millsaps & Harrington 2017; Milson et al., 2012). Milson et al. (2012) noted that GIS is not just an effective tool for geography education purposes, but its powerful attributes also extend into social studies instruction as well. They contend that GIS offers a great potential for making social studies education more practical and relevant. Teaching with GIS helps students to explore the “whys of where.” For example, GIS allows students to investigate why social studies topics, such as culture, religion, ethnicity, etc., are located where they are, and how they have changed over time. GIS technology helps to view, represent, and analyze data that supports social studies learning and teaching (Alibrandi, Beal, Wilson, & Thompson, 2000; Bunin et al., 2017).

The Role of ESRI in Facilitating the Use of GIS in Social Studies Classroom

Goodchild and Kemp (1990) were among the first to argue for the integration of GIS in secondary schools. They indicated that the availability of data, and the benefits of GIS to student learning, would offer the greatest potential gains in preparing students for their future life. As a result, educators began using GIS as an instructional tool in secondary schools, especially in social studies classrooms, from 1999 onwards (Milson et al, 2012). The relative affordability of computers at this time for most school districts was a key factor behind their encouraging the use of GIS in social studies classrooms (Keiper, 1999). Today, there are many organizations which encourage using GIS in secondary schools; ESRI has played a critical role in this effort. ESRI, established in 1969, is considered a global leader in GIS. The company has created a number of GIS-related products, including desktop GIS, web GIS, server GIS, and mobile GIS. ESRI’s primary objective is to develop technology, such as GIS, to solve real-world problems for achieving Sustainable Development Goals (ESRI, 2017). ESRI devotes their effort towards improving GIS to help all users (e.g. engineers, geologists, geographers, demographer… etc.) solve problems or make informed decisions. ESRI has also helped integrate GIS into schools to support student learning, dedicating a section of their website, “GIS for Schools,” to the endeavor. On this website, ESRI (2017) states:

> GIS helps educators teach better, students learn better, and schools work better. For over 25 years, we've been committed to helping schools thrive with software, curriculum solutions, and support for instruction and administrative uses. Today, we're more committed than ever to provide free online mapping tools and activities for schools. We

provide free instructional resources for getting started and going farther with online mapping. Standards-based instructional materials are available for a variety of subjects to enhance inquiry-based learning for students. These instructional materials require no installations or logins and work well on any connected computer, laptop, or tablet.

ESRI's efforts facilitate the integration of GIS into school curricula by providing three important resources: (a) ArcGIS Online (web map); (b) instructional materials; and (c) online teacher training courses. ArcGIS Online is a web-based GIS service which is both free-of-charge and easy to use. Moving away from desktop software towards a web-based GIS could more easily facilitate the incorporation of GIS into schools. Baker (2005) discussed the major advantage stating, "Using Internet-based mapping, the technical GIS work can be returned to curricular and technical developers, allowing teachers and students to more fully focus on learning with GIS," (p. 47). This affordable software package could encourage teachers to incorporate GIS into their lessons.

Moreover, ESRI provides several instructional resources for social studies teachers such as GeoInquiries activities and lesson plans. GeoInquires activities are used for teaching map-based concepts. They have been used to integrate ArcGIS Online technology with geographic inquiry to support social studies content. ESRI also provides suggested lessons to explain how GIS might be used to support geographic inquiry, and these lessons are 'ready-to-use'. Lessons focus on learning objectives, textbook references, and assessment items.

Finally, ESRI also provides materials related to teacher preparation, and training to integrate GIS in classrooms. In the "Educator Support" section of their website, there are many instructions and online tutorials for teachers to help them successfully integrate GIS into their classroom practices. All of these free materials offer clear, step-by-step instructions. There are also short web-based seminars for teachers on the site too. These courses are designed for teachers to acquire the requisite knowledge and skills to enable them to implement GIS within their own class instruction. Today, ESRI's efforts help facilitate the integration of GIS into schools around the world. Social studies teachers can use these materials to support their instruction.

The Potential of Using GIS in Secondary Social Studies Classrooms

The emergence of GIS has encouraged educators to see it as one of the most important techniques for implementing educational reform (Barstow, 1994). Using GIS technology in teaching social studies contributes to the faster achievement of educational goals in secondary schools (Aladag, 2010; Goldstein & Alibrandi, 2013; Singh, Rathakrishnan, Sharif, Talin & Eboy, 2016). Several studies have focused on the potential gains of incorporating GIS in social studies classrooms (Aladag, 2010; Artvinli, 2010; Fleischmann, Westhuizen & Cilliers, 2015; Goldstein & Alibrandi, 2013). These studies concluded that using GIS in the classroom improves student learning and abilities in four specific areas: (a) geographic inquiry, (b) critical thinking skills, (c) collaboration, and (d) motivation.

Geographic inquiry. Geography provides students with the content and skills to enable them to conduct geographic investigations. According to the National Council for Geographic Education (NCGE) (2017), students become actively engaged in "doing geography" if they acquire five geographic skills: (a) asking questions, (b) acquiring information, (c) organizing information, (d) analyzing information, (e) answering questions. These five skills can be developed by conducting a "Geographic Inquiry". Geographic Inquiry encourages students to "ask geographic questions, acquire geographic resources, explore geographic data, analyze geographic information and act upon geographic knowledge" (ESRI, 2003, p.1). The geographic inquiry always starts with questions, then proceeds through the collection, analysis, and interpretation of data to develop conclusions, suggestions, and solutions for action. Geographic inquiry requires students to "pursue a particular path of investigation, the end product of which is the student's ability to discover spatial insights and make deductions from their explorations of the lesson, rather than being provided with answers by the instructor" (DeMers and Vincent, 2008, p. 277). In the inquiry process, students investigate problems or questions deeply, and the geographic knowledge shifts from "What and Where?" to "How and Why?" (Golledge, 2002).

The main strength of GIS is its ability to facilitate geographic inquiry. Across the literature, there are many demonstrated cases which show that GIS can be used as an inquiry tool that empowers students to conduct geographical investigations to solve problems or make informed decisions (Baker, 2002; Favier et al., 2012; Huynh et al., 2012; Kinniburgh, 2012; Liu et al,. 2012). Keiper (1999) found that teaching through the actual use of GIS as an inquiry tool created "a shift from learning about geography to learning to do geography." (p. 57). He made a case study to investigate the potential for integrating GIS with geography teaching. In this study, students use basic functions of GIS such as "zoom", "measure distance", and "query" to solve problems such as route-finding on a digital map. He concluded that working with GIS encouraged students to use their geography skills, and the application, to solve the problem rather than simply memorizing place names or locations. Working with GIS provides opportunities for students to solve environmental problems, classify the world into regions, create “risk maps”, and population distributions (Milson et al. 2012) as well as the ability to explore, analyze, and interpret geographical problems in an interactive manner.

As an example, in Australia, students used GIS to investigate coastal erosion problems, and potential management strategies (Kinniburgh, 2012). In this study, students first determined the research project questions that they needed to answer. Secondly, they collected data from primary and secondary resources as well as their own fieldwork. In the fieldwork, students used GPS to plot locations and explored the coastal areas relative to their level of human activity. Finally, they entered all of their data into the ArcGIS program and used effective spatial analysis tools in ArcGIS such as spatial analyst, 3D analyst extensions, Aerial Photography, and a digital Elevation Model to create natural hazard maps which highlighted the potential threats. This example used a constructivist learning framework where students used GIS as an inquiry tool to actively engage with their own learning to explore real-world problems.

Another useful example of geographic inquiry comes from a project which took place in New Zealand. Eddy & Olsen (2012) describe a case study where a secondary school named “Chilton Saint James School” used GIS in the classroom. In 1999, the school created a semester-long GIS program which focused on an inquiry model and problem solving strategy. Students in this program worked with GIS to conduct the spatial analysis of a vineyard. They calculated the proportion of land used and created GIS maps about fire risk in the vegetation around “Lower Hutt” City. This project was so successful that it won a New Zealand/Australian competition. The researcher concluded that GIS activities fostered the students’ geographic inquiry and problem-solving skills. The project also provided students with the opportunity to use GIS to facilitate the inquiry process with which to make informed decisions. Another example, this time from the United Arabic Emirates (UAE), is a project where students used GIS to select the best locations for a school (Bualhamam, 2012). In this project, students used GIS tools to determine the nearest school to their home, and how many people lived nearby. Based on this research they then had to propose the best location for a new school, while taking into consideration criteria such as travel distance, proximity to population centers, and accessibility from roads.

Moreover, using GIS through inquiry based practice method can help tackle the issue of explaining the historical construction of a space (Radinsky, Hospelhorn, Melendez, Riel & Washington, 2014; Huynh et al., 2012). GIS helps to integrate geography with history in significant ways, because geography is space and history within a time framework. Thus, using GIS enables students to engage in a temporal-spatial analysis of historical data to deepen their understanding of potentially complex issues. For example, Radinsky et al. (2014) used backward-design to develop a "Latino and African American migrations" instruction unit for middle school and college social studies students. This unit focused on teaching history by using GIS "web map" census data. In their study, students conducted a historical investigation and inquiry by using internet-based, GIS mapping to answer questions about "how a local neighborhood's population changed over time" (p.146). The researchers concluded that the GIS enabled students to trace, compare, describe, and make inferential connections about population changes over time. The students could also provide reasonable evidence and explanation about *why* the population changed.

Similarly, in Canada, Huynh et al. (2012) describe a case where GIS was used in a research-based learning framework to analyze a historical topic. In this study, the head social studies department teacher named "Teresa" at Hants East Rural High School developed a geomatics course which integrated history with GIS tools. In this course, students went on a field trip to a local cemetery. They then used a GPS unit to record historic locations, while also collecting data about those places. After this field trip, the students worked with a GIS to record all the information they had gathered and created historical maps about soldiers and ethnic groups. The researchers concluded that working with the GIS gave students a "sense of spatial awareness" (p.42). In both examples, using GIS facilitate inquiry which improved student skills in spatial, temporal and correlational analysis.

In the previous examples, students responded to questions in a geographically distinctive way. They planned an inquiry, collected, analyzed, interpreted, and created solutions. They then made suggestions or judgements using what they had just learned (Milson et al., 2012). The unique nature of conducting inquiry through GIS technology is the focus on spatial characteristics or locations to conduct inquiries and reach conclusions. The premise of geographical thinking is to promote ways of understanding "where something is, how its location influences its characteristics, and how its location influences relationships with other phenomena." (ESRI, 2003, p.1). Using GIS as a geographic inquiry tool encourages spatial analysis of the data which can provide students with new ways to understand these phenomena through interaction with visual representations of these data.

Critical thinking skills. Critical thinking is defined as higher-order thinking that requires analysis, synthesis, and application (Moore & Parker, 2009). Paul and Elder (2008) argue that "the quality of our life and that of what we produce, make, or build depends precisely on the quality of our thought" (p.4). For this reason, teaching critical thinking skills has been an essential mission for educators and is important in preparing responsible and engaged citizens (NCSS, 2010; Sahinel, 2002). Students have to make reasoned decisions through "discussions, debates, and the use of authentic documents, simulations, research, and other occasions for critical thinking and decision making" (NCSS, 2008, p.181). By using higher levels of thinking, students are better able to understand and appreciate other people's lives and events (Godfrey & Grayman, 2014). Developing critical thinking skills also prepares a student to become an informed citizen in an open and democratic society (NCSS, 2010). Thus, social studies curricula should incorporate critical thinking skills and activities to help students not only achieve the course goals, but also to improve society as a whole.

Paul, Binker and Weil (1993) outlined that instruction plays an essential role in promoting students' critical thinking skills in social studies classrooms. Many studies revealed that GIS is an effective tool for instruction that improve students' critical thinking skills (Milson et al., 2012). Via GIS, students use "reasonable reflective thinking about the relationship between mankind and environment focused on deciding what to believe or do in situations where location matters" (Hooghuis, van der Schee, van der Velde, Imants & Volman, 2014, p. 243). Students are able to think logically, to investigate the relationships between location, people, and environment, and to develop conclusions or evidence that can come in the form of explanation, prediction, or judgement. This kind of thinking helps students reach higher levels within Bloom's taxonomy (West 2003; Zhang, 2007).

Many studies indicated that using GIS in social studies instruction support students' critical thinking skills (West, 2003; Zhang, 2007). For example, in Beijing, Zhang (2007) measured the relationship between using GIS in social studies classrooms and critical thinking. He conducted his study on two social studies high school teachers in a geography lesson titled "The factors that influence patterns of population density in Beijing city". Group (A) was the control group where students used data from the internet and Group (B) used GIS software to create maps. The results indicated that students who used GIS recorded higher critical thinking according to Bloom's Taxonomy. They recorded higher scores in comprehension, application, analysis, synthesis, and evaluation. Similarly, in Singapore, Liu, Bui, Chang and Lossman (2010) used quasi-experimental methods to measure the effect of integrating GIS within problem-based learning instruction upon the learning outcomes in secondary school geography education. Researchers divided participants into two groups; a Control Group, which consisted of 25 students who received instruction on "The Human Population Dynamic" unit via Problem-Based Learning (PBL), and the Treatment Group which comprised 24 students who learned the same unit by integrating GIS with their PBL instruction. Researchers designed three PBL activities for both groups to analyze the population distribution and density activity, then address a locally-related problem concerning population. The students received an ill-structured problem to solve it. Each group took a test before and after the project to measure their relative cognitive improvement from working on the project. The results revealed that using PBL-GIS increased the students' higher cognitive thinking by improving their analytical and evaluation skills rather than just the lower cognitive skills of memorization and recalling information as achieved by the PBL-only test group. Heong, Yunos and Hassan (2011) indicated that improving higher order thinking skills among students prepares them to effective performance and future career.

Another benefit offered by GIS-based instruction is that students always work with GIS to create maps that show the phenomena under study. "Creating maps" is an essential critical thinking activity which Bloom (1956) defines as creating the highest form of thinking. For example, in Taiwan, students worked in GIS-based projects to create water quality and landslide prediction maps (Chen, 2012). In this study, students analyzed aerial photos, calculated hill slope, and evaluated water quality parameters with GIS tools to create future water quality and landslides maps. Additionally, in Switzerland, students used GIS to assess the problem of sea-level rise (Stark & Treuthardt, 2012). In this study students worked with GIS to spatially analyze the relationship between population and coastal areas, and they were then able to suggest appropriate solutions to the problems they discovered. In both examples, students used higher-order thinking such as analysis, synthesis, and application to solve problems or make decisions. Students created maps that showed the costal hazard areas to enable them to suggest appropriate solutions to the problems that they discovered. In both examples, students used the highest form of thinking “create” to present their results in form of maps.

Collaboration. Collaboration is one of the essential skills for supporting civic competence in our democratic republic (NCSS, 2008). Several research reports have observed that learning tends to be more effective when students are given the opportunity to work together to achieve specific goals (Chiriac, 2008; Means, Toyama, Murphy, Bakia & Jones, 2009; Siew, Chong & Lee, 2015). GIS is one of the tools that provides an avenue for creating collaborative learning environments to effectively achieve a common goal (Keiper, 1999; Milson & Earle, 2008; Sierra & De la Rosa, 2012). For instance, Milson and Earle (2008) conducted a case study to explore the effects of using internet-based GIS (IGIS) on ninth grade students in an inductive learning environment. In this study, students worked on a Pan-African Summit project collaboratively. The teacher divided students into groups, and each group represented part of Africa. Students worked with data that included three specific features; Economic, Human, and Physical. Each group connected these features in each country within maps and proposed solutions to specific problems. They then made a presentation that showed their work, which included maps, graphics and images. The results showed that students enjoyed this activity because they explored a topic of interest freely, worked collaboratively and shared their strategies with others.

In another research paper, Liu and Zhu (2008) argued that working with GIS fosters social constructivism, because GIS enables collaborative knowledge construction where students work in groups, share their knowledge with others, and create maps through social interaction. In Japan, students worked on a GIS project to identify the potential for suspicious people to hang around the school grounds, and how they might be hazardous to the community (Ida & Yuda, 2012). Firstly, the teacher explained maps that showed the appearance of strangers, and then they asked students to guess the locations where strangers had actually been observed. Secondly, the teacher divided the class for fieldwork into 10 groups. Each group had from 3 to 5 students depending upon the size of the area they had to explore. Each group used overlay functions in GIS to examine the relationship between darker places and suspicious persons. Finally, the students shared their results with other groups, and held an open discussion to learn from each other and improve their work. GIS activities enabled students to construct their knowledge by interactivity with their environment and their group partners.

Collaboration between students through GIS-based projects has shown that it can improve a student's sense of responsibility (Keiper, 1999). It also provides them with project management skills (Milson et al, 2012), which are essential in preparing for future citizenship. In a related example, Keiper (1999) studied the potential for using GIS in geography classrooms. Teachers divided students into groups to work on GIS-based projects to solve specific problems. The results of this study indicated that working on such projects improved a student's responsibility to make their own decisions and formulate their own strategies to solve problems.

Motivation. Students' motivation in the social studies classroom is very important for active learning. Motivation facilitates learning (Turner & Patrick, 2004) through enhancing student attention, and furthering their understanding of new concepts (Pintrich &Schunk, 2002). Social studies teachers thus need new strategies to motivate students. In some instances, they have implemented different forms of technology and media to enhance student interest, such as electronic games or videos (Sardone & Devlin-Scherer, 2010; Shah, Foster & Barany, 2017). A number of researchers have argued that using GIS technology in social studies classes' increases student motivation and interest (Aladag, 2010; Borian, 2012; Jekel, Koller & Strobl, 2012; Milson & Earle, 2008). There are many reasons why this is so, although it isn't specifically the act of working with GIS that increases motivation, but rather the way the technology is employed.

For instance, students working within groups on GIS-based projects typically do experience extra motivation to complete their activities (Borian, 2012; Jekel et al, 2012; Keiper, 1999; Milson & Earle, 2008). Worthy (2000) indicated that project-based learning enables students to guide and manage their learning through self-direction. For example, in Hungary, using GIS through the project-based learning process has been observed to foster students' motivation to actually complete their research projects, which can positively impact their future careers (Borian, 2012). This GIS-based project got students to collect, analyze, and create water quality maps. Its primary goal, however, was to "motivate the students to continue their further studies as scientific researchers" (p. 130). It ultimately succeeded, and this study concluded that the GIS project-based learning environment engaged students with their efforts and thus increased their motivation to carry on with their scientific endeavors.

Moreover, GIS technology provides students with the opportunity to investigate real-world problems. And research suggests that students are more motivated to learn if the subject matter under investigation is interesting and connected with real-world issues or everyday life (Kubiatko, Janko & Mrazkova, 2012). For instance, Radinsky et al, (2014) studied the effects of using GIS-based mapping on students learning in history classrooms. As mentioned before, students investigated how a local neighborhood's demographics had fluctuated. They looked across GIS data and text to trace how the population changed over time. They also conducted fieldwork, such as interviews with community elders, to collect data about migratory experiences. The research paper's authors saw the student experiences in this project as "a meaningful source of knowledge for social inquiry" (p.152). Students compared the data in the GIS with the data they collected themselves to yield evidence on why the population changed, including details such as "racial segregation". Similarly, in Austria, Jekel et al. (2012) showed a case study for applying GIS in the secondary geography classroom. Students worked in groups using GIS and their own research on a project titled "*The Schools on Ice",* which investigated the localized effects of climate change. In this project, students did fieldwork to collect data about the physical and economic effects of climate change, analyzing data by using GIS. They published their results, including GIS maps, in an Austrian journal. In both examples, using GIS provided students with the opportunity to interact with both their local environment and their peers. Barton and McCully (2007) Research shows that students who examine real-world problems or controversial issues in such detail will also develop an interest in participating in a democratic society.

Furthermore, Singh et al. (2016) indicated that using GIS-based instruction fosters the mastery goals in underachieving students. Instructors designed an eight-week long GIS-based instruction unit entitled "'The Distribution of the Forests and Wildlife in the World". In this unit, students worked with GIS to discover and compare forest areas around the world. The findings of this study showed that groups which used GIS-based instruction recorded higher goal mastery scores than the control group, and that there were significant performance increases between pre- and post-project testing. Authors indicated that learning through GIS both enhanced student interest and curiosity, not to mention actually encouraging them to learn the topic.

The Challenges of Using GIS in Secondary Social Studies Classrooms

Despite the potential for GIS to enhance student learning, only a few secondary schools employ it so far due to technological, pedagogical, and administrative barriers. Kerski (2003) reported that just 2% of secondary schools use GIS in their curricula. Across the literature, many studies have discussed the challenges of integrating GIS in secondary social studies classrooms (Golledge, Marsh & Battersby, 2008; Kerski, 2003; Milson et al, 2012). There are eight main challenges to overcome in order to increase the use of GIS in the classroom:

1. A lack of pedagogical resources. Previous research indicates that the lack of pedagogical resources and materials which clarify how to integrate GIS into social studies instruction have hindered the technology's implementation (Hong & Melville, 2018; Kerski, 2003; Lam et al., 2009; Millsaps & Harrington 2017). There is, therefore, a need for a clear pedagogical plan and resources that both shed light on the importance of GIS, and offer methods for how to employ it in social studies classrooms.
2. Curriculum Absence. GIS is not included in the curriculum and standards in many countries (Kinniburgh, 2012; Oppong & Ofori-Amoah, 2012; Salamanca & Vega, 2012). Milson et al. (2012) indicated that out of 33 countries studied, only eight embedded GIS in official secondary school curriculum and standards: China, Finland, India, Norway, South Africa, Taiwan, Turkey, and the United Kingdom. In Ghana, for instance, Oppong and Ofori-Amoah (2012) indicated that "GIS is currently not part of the secondary school curriculum" (p. 118), thus creating a significant challenge to its use as "the curriculum of secondary education in Ghana is highly standardized, without much room for change by teachers in terms of content and topics" (p. 118).
3. Teacher Preparedness. All countries currently face a lack of teacher preparedness and training in GIS-based instruction. This applies to both pre-service teachers, as well as those in-service. Many researchers indicate that teachers' limited GIS skills and knowledge prevents them incorporating it into their classrooms (Akinyemi, 2015; Kerski, 2003; Milson et al., 2012). In Rwanda, Akinyemi (2015) conducted a study to identify the challenges teachers face when they want to use GIS in classrooms. The study indicated that teachers are confused by the system, and do not feel confident using GIS when teaching geography. Problems related to teachers' lack of preparation and readiness were also cited by studies in Austria, South Africa, and Canada (Eksteen et al., 2012; Huynh, et al, 2012; Jekel et al, 2012).

4. Software availability. Some countries are challenged by a lack of GIS software availability in secondary schools (Ida & Yuda, 2012; Kerski, 2003; Milson et al., 2012). For example, Ida and Yuda (2012) indicated that the cost of software lead to lack using GIS in secondary schools in Japan.
5. Electricity and Computers. Many countries also face limited access to computers or even electricity. In Uganda, Ghana, and India, the limited infrastructure includes a deficiency of computers, electricity, and laboratories, which obviously creates significant GIS-implementation challenges, especially in rural areas (Ayorekire & Twinomuhangi, 2012; Oppong and Ofori-Amoah, 2012; Tiwari & Tewari, 2012).
6. Lack of Good Data. Another issue that some countries face is a lack of relevant spatial data or poor quality data (Jekel et al, 2012; Jensen, 2012; Tiwari & Tewari, 2012). Jekel et al. (2012) stated that "GIS software and data are not widely available for secondary schools" p.63.
7. Time. The time requirements to prepare lesson plans based on GIS, or training teachers to use them can be prohibitively demanding (Kerski, 2003; Milson et al., 2012). Kerski (2003) conducted a study to assess the implementation and effectiveness of GIS in American secondary schools. He surveyed nearly 1500 high school that own GIS software. The results showed that less than 2% American high schools have been adopted GIS. Teachers indicated that one of the big challenges is time. They spent long time to develop GIS-based lesson plans. Morover, over 62 percent of teachers indicated that they "spent at least one hour per week outside of class time with GIS" (p.130).
8. Awareness. Finally, there is a general lack of awareness, especially in education policy, of strategies that encourage schools to use GIS. Many education policymakers simply do not understand how geography and social studies have changed in the 21st century. In Canada, Huynh et al, (2012) indicated that the lack of a national education policy and curriculum inhibited the use of GIS in secondary schools. In France, Sanchez, Genevois, & Joliveau (2012) suggested that improving education policy is important for GIS integration. In addition, in Germany, Viehrig and Siegmund (2012) indicated that a lack of research about the effectiveness of GIS has actually led to a decrease in the awareness of its importance. In summary, identifying the difficulties

of integrating GIS in classrooms is highly significant, as it leads to the determination of a number of important implications for future practice.

Theoretical Framework

There is a need to define a clear theoretical framework for designing and developing GIS instructional model for social studies classrooms. A theoretical framework helps to guide the entire process of designing, developing, and evaluating a GIS instruction model. In this regard, the GIS model was based upon the underlying vision of the AIW framework. This study used the AIW framework as its guide, while also integrating NCSS ideas and the C3 framework that underlies the AIW framework itself.

The Authentic Intellectual Work Framework

Despite the numerous modes of curriculum reform around the world, instruction and assessment, in the classic sense, still remains traditional in its approach toward education (King, 2016). Traditional instruction is a teacher-centered approach wherein the teacher is the primary source of information being conveyed to students. The classroom teacher is the sole leader, taking responsibility for all learning processes and making rules for classroom protocols (Rogers & Freiberg, 1994). Traditional social studies instruction has always focused on the memorization of large amounts of text and requires the recall of information and basic facts from the students, such as dates, names, places, etc. (Fielding, 2005). The literature has shown that teachers devote too much time to lecture-type instruction (Meguid & Collins, 2017). As a result, a student's low engagement in learning, as well as their passivity as a learner, is observed a majority of the time (Freiberg, 1999). Social studies instruction has to be intellectually challenging for students, and must enhance their level of thinking in an effort to build on their knowledge.

The NCSS (2010) affirms that, "[t]he aim of social studies is the promotion of civic competence — the knowledge, intellectual processes, and democratic dispositions required of students to be active and engaged participants in public life" (p. 9). For students to become civically competent, their instruction has to encourage them to be curious and inquiring. This form of social studies instruction focuses on teaching critical thinking skills and having students make informed decisions and problem-solve instead of memorizing content (NCSS, 1993). The purpose of social studies is to achieve NCSS visions to prepare students for work, college, and career challenges. The framework for AIW reflects NCSS standards for the most effective forms of teaching and learning. As per its founders Carmichael, King, and Newmann, the AIW framework focuses on the teacher's ability to structure tasks which allow their students to make informed decisions and achieve success on specific tasks. King et al. (2009) corroborate this point:

For most students in most schools, the usual work demanded of them is rarely meaningful, significant, or worthwhile. Learning tasks still tend to call for memorizing and reporting on specific information and content, rather than asking students for higher-level thinking, interpretation, or problem solving. The challenge for students is to comply with teachers' and tests' requirements, rather than to use their minds to solve meaningful problems or answer interesting and challenging questions. (p. 43).

The AIW framework is designed to prepare students for lifelong intellectual demands. This is achieved by encouraging students to engage in rigorous work, developing their capacity for in-depth understanding, and raising their interest in academic work itself. AIW's three main criteria are: (a) construction of knowledge, (b) disciplined inquiry, and (c) value beyond school. These three tenets provide the foundation of a student's intellectual work necessary for social, professional and civic success (King et al., 2009). As defined by these authors *construction of knowledge* refers to organizing, interpreting, synthesizing, and evaluating prior knowledge to solve unique problems. To meet this criteria, students receive instruction on how to think critically to bring themselves new understanding by analyzing novel problems. The concept of *disciplined inquiry* seeks to develop deeper understanding by exploring the connections and relationships between key facts, concepts, claims, and events. Inquiry is used to encourage students to achieve complex understanding by addressing central ideas, and engaging in conversational exchanges with teachers and peers to build a shared understanding. *Value beyond school* involves students presenting their knowledge in verbal, written, or visual ways about the topic that relates to real world issues and personal experiences. Meeting these three criteria leads a student to create "authentic work".

The AIW framework provides the instruction guidelines to help teachers improve quality learning for diverse groups. Table 2 illustrates the standards for instruction, assignments, and student work based on the three criteria of AIW. Each standard is accompanied by a scoring rubric to evaluate a teacher's ability to develop a student's authentic intellectual quality.

Standardized rubrics guide a teacher’s classroom practices and provide a significant tool for professional development and collaboration.

Table 2

Criteria and Standards for AIW

Criteria	**Standards**		
	Instruction	**Assignment**	**Student Work**
Construction of Knowledge	**Higher Order Thinking:** Instruction encourages students to produce new understanding by critical thinking such as synthesizing, generalizing, and hypothesizing information.	**Construction of Knowledge:** The assignments ask students to construct their knowledge through addressing concepts, problems and disciplined issues by organizing and interpreting information.	**Analysis:** Students analyze information by making models, simulations, conducting arguments and discussing alternative points of views.
Disciplined Inquiry	**Deep Knowledge:** Instruction encourages integrated and holistic understandings.	**Elaborated Written Communication:** Students express their knowledge in written ways developing conclusions and explanations.	**Disciplinary Concepts:** Students demonstrate understanding of disciplinary concepts.
	Substantive Conversation: Instruction encourages students to engage in conversational exchanges with their teachers and peers to build and shared understanding of ideas		**Elaborate Written Communication:** Students express their understanding through extended writing assignments.
Value Beyond School	**Connection to the World Beyond the Classroom:** Students make relationships between knowledge and real-world issues and personal experiences.	**Connections to Students’ Lives:** The assignments ask students to address real-world issues.	——

AIW is summarized as “the construction of knowledge, through the use of disciplined inquiry, to produce discourse, products, or performances that have value beyond school” (King, 2016). Newmann et al., (2015) illustrate that to construct knowledge through inquiry, students need to: (a) use prior knowledge, (b) strive for in-depth understanding, and (c) develop and express their ideas through elaborated communication. When students construct knowledge through inquiry, they need to already possess a knowledge base of facts, concepts, theories, and skills. These individual elements must not be isolated. Students need to test relationships between facts and concepts to deepen their understanding. Additionally, they must be able to present their understanding either verbally or through written word in multiple formats including graphs, essays, narratives, or research findings, etc.

As to the practical applications, social studies teachers should encourage their students to "engage in collaborative learning, use high-order thinking skills, construct their own knowledge about social studies concepts, and relate classroom lessons to their lives and experiences" (Rice & Wilson, 1999, p.32). This can be achieved through practicing AIW in the classroom. Research indicates that integrating digital technologies facilitates and sustains AIW criteria in social studies classrooms (e.g., Hicks et al., 2004; King, et al., 2009). The AIW framework can be used as the basis for good teaching with technology and requires an understanding of how using technology can also promote AIW objectives. Teachers must guide their students to construct knowledge in order to produce maps of real world value.

As discussed in the literature review, GIS has the potential for improving student learning, which is why many consider it to be a technological tool that can foster AIW in social studies classrooms. The literature has shown that students always used higher-order thinking during the inquiry process they used to create their GIS projects with relevance to real-world issues (Baker, 2002; Kerski, 2003 & Milson et al, 2012). For example, in Japan, students used GIS as an inquiry tool to determine the dangerous places near their school (Ida & Yuda, 2012). Students analyzed the location, lights, buses, and crime rates. They investigated the relationships between the darker places and the observed suspicious persons with a view to decreasing crime incidents. Researchers have concluded that using GIS in this way provides students the opportunity to participate in society while they "learn to behave as community members" (p.142). Parker (2012) indicated that using GIS during the inquiry process is considered the highest form of higher-order thinking, because "learning by seeking information through questioning heightens students' interest and allows for creative investigations and deep analysis" (Pellegrino & Kilday, 2013, p. 3).

In this study, developing a GIS Instruction Model focused on the construction of knowledge through geographic inquiry to produce performance that has practical value beyond educational confines by *'doing inquiry'*. As students read, collect data, analyze data, and think critically to make informed decisions about something relevant to their lives, they increasingly become global thinkers and problem solvers. “Doing inquiry means doing it again and again — cycling through repeated rounds of data-gathering and claim-building” (Parker, 2012). Designing a GIS inquiry model is important, because it can help prepare students to become engaged citizens in a democracy, thus fulfilling the key mission of social studies instruction. In brief, the AIW framework implies that, when conducting their disciplined inquiry, students should work collaboratively, engage in discussion, communicate with others, and using critical thinking skills to construct deep knowledge which will enable them to productively address topics that are relevant to their lives and/or the world around them. Thus the development of GIS Instructional Model seeks to facilitate the following AIW criteria: (a) construction of knowledge, (b) deep knowledge, (c) critical thinking skills, (d) elaborated communication, (e) discussion and conversation, and (f) value beyond school through performing inquiry.

Theory in Practice

Ideas and rules are often fine in theory, but not in practice. Theory provides general rules, but it cannot tell us how to apply them in reality. In this case, a practical model is needed to unify theory with practice. In this study I used an IDM to create an effective instructional model that helps to provide a practical example for how to employ GIS to facilitate AIW in social studies curricula. In this model, couple of lessons that were designed in IDM format and followed AIW framework worked as part of an overall curriculum which guides the learning process to improve student knowledge and skills.

Swan, Lee and Grant (2015) designed the IDM to create curriculum material that fosters inquiry in the Arc of College, Career, and Civic Life (C3). In this model, inquiries receive support through a compelling question which addresses a topic in the academic discipline and allows students to reflect upon their experiences as related to this topic. Saye (2017) echoes many likeminded scholars in stating that in social studies instruction “the practice of inquiry holds a central role in conceptions” (p. 336). IDM seeks to achieve the C3 framework as designed by the NCSS (2013). The intention is to enable teachers and students to engage in inquiry-based learning by creating an inquiry arc aimed to prepare them for a civically engaged adult life. The C3 framework “spark[s] curiosity, guide[s] instruction, deepen[s] investigations, acquire[s] rigorous content, [to] enable students to apply knowledge and ideas in real-world settings” (NCSS, 2017, p. 8). IDM works to achieve all four dimensions of work under the C3 standards umbrella: (a) questioning; (b) applying disciplinary concepts and tools; (c) gathering, evaluating, and using evidence, and (d) working collaboratively and communicating conclusions. These dimensions advocate that students conduct investigations and ask questions which are important to them, as well as to identify the knowledge and tools that can help them to answer their questions and create conclusions which support their understanding of the inquiry.

As stated earlier, this study used IDM to provide a practical example of how GIS could be used as an inquiry tool to facilitate AIW. It therefore integrated AIW criteria within the IDM. Furthermore, it illustrated how GIS will work as an inquiry tool to solve novel problems that need to use higher-order thinking, such as synthesis, analysis, and evaluation. Additionally, the problems under study had to be relevant to real-world issues or personal lives. Creating the GIS instruction model followed the inquiry-based learning model to develop student understanding of geographic concepts. This model emphasizes AIW criteria and standards which, with the integration of disciplined inquiry, enhances student ability to construct their knowledge through “doing inquiry” to produce products of later worth in adulthood. Table 3 represents IDM blueprint and illustrates the key components (e.g. compelling question, supporting questions, performance tasks, and featured sources).

Table 3

IDM Blueprint with Description

<table>
<tr><th colspan="3">Inquiry Design Model (IDM) Blueprint™</th></tr>
<tr><td>Compelling Question</td><td colspan="2">Compelling questions address issues found in and across the academic disciplines that make up social studies. Compelling questions reflect the interests of students and the curriculum and content with which students might have little experience.</td></tr>
<tr><td>Standards</td><td colspan="2">The key standard (1-2) that is the foundation for the inquiry.</td></tr>
<tr><td>Staging the Question</td><td colspan="2">Staging the question activities introduce students to the ideas behind the compelling question in order to generate curiosity in the topic.</td></tr>
<tr><td>Supporting Question 1</td><td>Supporting Question 2</td><td>Supporting Question 3</td></tr>
<tr><td colspan="3">Supporting questions are intended to contribute knowledge and insights to the inquiry behind a compelling question. Supporting questions focus on descriptions, definitions, and processes about which there is general agreement within the social studies disciplines, which will assist students to construct explanations that advance the inquiry. Typically, there are 3-4 supporting questions that help to scaffold the compelling question.</td></tr>
<tr><td>Formative Performance Task</td><td>Formative Performance Task</td><td>Formative Performance Task</td></tr>
<tr><td colspan="3">Formative Performance Tasks are activities designed to help students practice the skills and acquire the content needed to perform well on the summative task. These tasks are built around the supporting questions and are intended to grow in sophistication across the tasks. The performance tasks threaded throughout the inquiry provide teachers multiple opportunities to evaluate what students know and are able to do so that teachers have a steady loop of data to inform his/her instructional decision-making</td></tr>
<tr><td>Featured Sources</td><td>Featured Sources</td><td>Featured Sources</td></tr>
<tr><td colspan="3">Each Formative Performance Task should have 1-3 disciplinary sources to help students build their understandings of the compelling and supporting questions and to practice the work of historians and social scientists. To that end, sources can be used toward three distinct, but mutually reinforcing purposes: a) to generate students' curiosity and interest in the topic, b) to build students' content knowledge, and c) to help students construct and support their arguments related to a compelling question.</td></tr>
<tr><td rowspan="2">Summative Performance Task</td><td>Argument</td><td>Each inquiry ends with students constructing an argument (e.g., detailed outline, drawing, and essay) that addresses the compelling question using specific claims and relevant evidence from sources while acknowledging competing views.</td></tr>
<tr><td>Extension</td><td>An extension activity offers an optional task that might be used in place of the Summative Performance Task.</td></tr>
<tr><td>Taking Informed Action</td><td colspan="2">The three activities described in this space represent a logic that asks students to a) understand the issues evident from the inquiry in a larger and/or current context, b) assess the relevance and impact of the issues, and c) act in ways that allow students to demonstrate agency in a real-world context.</td></tr>
</table>

Source: Grant et al., 2017.

Chapter Summary

Four major topics were presented in this chapter: (a) geography is a core component of social studies, (b) the context of geography is secondary social studies education in Kuwait, (c) the Geographic Information System, and (d) the theoretical framework. These four topics provide the contextual background and theoretical foundation of the study. Chapter 3 will detail the methodology used in this study.

CHAPTER 3
METHODOLOGY

This chapter describes the methods and procedures which informed the design, development, and validation of a GIS Instructional Model. This Chapter comprises the following sections: (a) restatement of the research purpose and questions, (b) research design, (c) developmental study procedures, and (d) quality of the research. (Please note that the model's development phases, along with data collection and analysis, are discussed in 'developmental study procedures').

Restatement of Research Purpose and Questions

The purpose of the study is to design, develop, and validate a GIS Instructional Model for Kuwaiti social studies teachers to facilitate AIW in their classroom. The GIS Instructional Model sought engage students to work with GIS to facilitate the following AIW criteria (a) construction of knowledge, (b) deep knowledge, (c) critical thinking skills, (d) elaborated communication, (e) discussion and conversation, and (f) value beyond school through performing inquiry. The following research questions guided the study:

RQ 1: How can a GIS Instructional Model be designed from a pedagogical standpoint, to facilitate social studies inquiry and Authentic Intellectual Work?

RQ 2: What barriers exist for integrating this GIS Instructional Model into Kuwaiti social studies classrooms, and can anything be done to remove these obstacles?

Research Design

Richey and Klein (2007) defined developmental research as, "…the systematic study of design, development, and evaluation processes with the aim of establishing an empirical basis for the creation of instructional and non-instructional products, or tools, with new or enhanced models that govern their development," (p. xv). Furthermore, the design and development research approach provides a set of procedures and a fundamental knowledge base for instructional design and models (Richey & Klein, 2007). These characteristics seemed an excellent fit for this study, so the researcher selected a design and development research approach to design, develop, and validate a GIS Instructional Model to facilitate AIW in Kuwaiti social studies classrooms.

Richey and Klein (2007) described developmental research as an applied investigative approach that provides methods for creating a link between theory, design and practice. Furthermore, Richey, Klein, and Nelson (2004) indicated that design and development research offers a solution to practical problems by creating models or tools. Richey and Klein (2007) indicated that the process of developing instructional design is similar to the problem-solving process in a scientific field. As such, the instructional model that the researcher works to develop provides appropriate solutions to specific problems (Thomas & Rothman, 1994). Adding to this, throughout the design and development process, researchers apply scientific methods to enhance their understanding of the overall endeavor (Richey, Klein, 2007). This is vital for advancing the field of instructional development, because it is through developmental research that models and tools emerge for guiding design, development and evaluation processes (Richey, Klein, & Nelson, 2004). The first step in the research process is selecting the problem to study.

The researcher decided to address a problem in social studies education which concerns the lack of a theoretically-grounded GIS Instructional Model that explains how to integrate the GIS technology into classroom practice to improve student AIW. This resulted in the creation of a GIS Instructional Model to bridge the gap between theory and practice; taking ideas about inquiry and AIW and turning them into a useful product for classroom instruction. The researcher followed specific scientific methods and procedures to achieve this aim, and describes them in the following section.

Richey & Klein (2007) outlined two types of developmental research: (Type 1) Product and Tool Research, and (Type 2) Model Research. The differences between these two categories depend upon how generalizable or contextually specific the research results prove to be. Type 1 involves, "…situations in which the product development process used in a particular situation is described and analyzed and the final product is evaluated," (Richey, Klein & Nelson, 2004, p. 1102). It focuses upon the design, development, and evaluation of a specific product, tool, or program. In contrast, Type 2 involves, "...the common (but not exclusive) situation in which this research takes place after the actual design and development process is completed," (Richey, Klein & Nelson, 2004, p. 1103). The Type 2 model is more generalized in nature and has a generic focus. In summary, Type 1 research is contextually specific, whereas Type 2 has broader application (Richey & Klein, 2007). This developmental study sought to build a GIS Instructional Model specifically for grade 12 social studies classrooms in Kuwait. The Type 1 developmental research method seemed the most appropriate process to employ in this case, because this study generated a new model, available for specific use.

Developmental Study Procedures

The development study used Richey and Klein's (2007) methodology of 'design and development' to reach its goals. Along those lines, a literature review, coupled with feedback from expert reviewers, assisted the model's development and validation processes. The researcher employed the following five phases to design, develop and validate this model: (a) selection of model components and theoretical foundation, (b) analysis and development, (c) formative evaluation, (d) revision, and (e) usability evaluation. Figure 4 depicts an overview of the study's procedure.

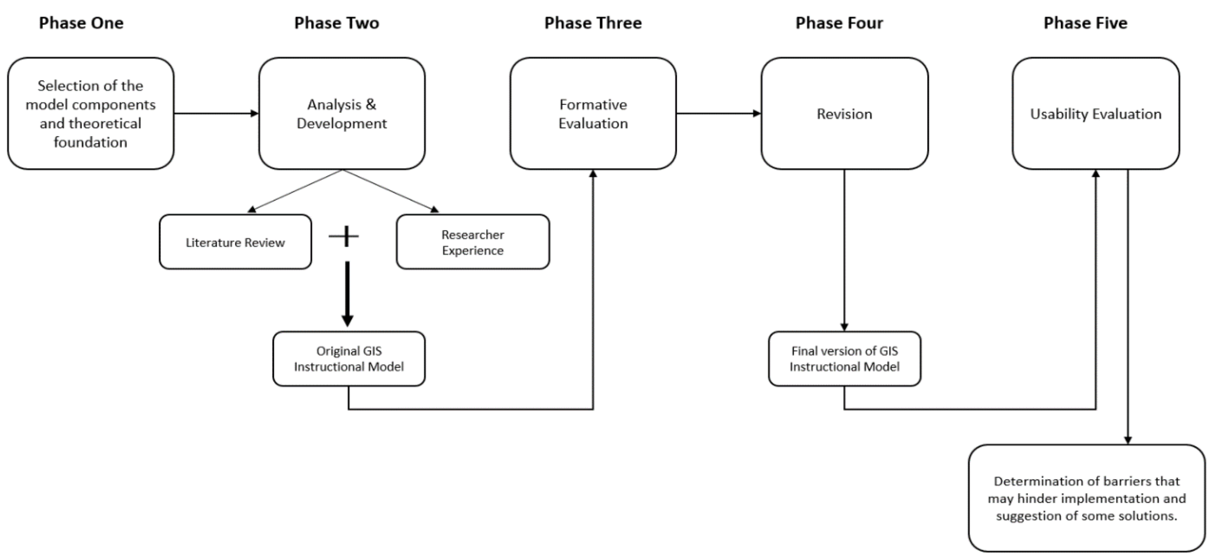

Figure 4. Developmental research phases.

However, before entering a discussion regarding the development phases, it important to provide an overview of the model itself. The model is a teaching model that comprises less than an instruction unit in size, but more than a lesson. It explores world population growth, a topic which already exists within the Kuwaiti grade 12 geography curriculum. The world population growth topic fits in the 'population geography unit' which is divided into three main areas: (a) population growth; (b) population movement and distribution; and (c) population density. As it happens, 'population growth' is the first topic in this unit as taught in Kuwait; it occupies more than half of the allotted class periods. In Kuwait, teachers currently instruct this unit without the benefit of GIS; they primarily rely on the textbook and use paper maps. The GIS Instructional Model is designed to enhance the teaching of the population growth topic in Kuwaiti secondary schools, and to provide a practical example for how GIS could be incorporated into social studies classroom practices to support AIW. It comes ready to implement in geography instruction at a Grade 12 level. Teaching this model will take between nine and eleven 45-minutes class periods to complete. Table 4 provides a description of the GIS Instructional Model.

Table 4

Description of GIS Instructional Model

Model Topic	World Population Growth
Model Form	Teaching Model: it comprises less than a teaching unit in size, but more than a lesson. It includes lessons which address global population growth.
Subject	Geography
Grade	12
Model Lessons	Five main lessons: • World population changes over time and space. • The causes of population growth • The consequences of population growth • Argumentative essay addressing population growth effects • Project-based GIS addresses population growth in Kuwait
Model Objectives	The model seeks to engage students in working with GIS to complete inquiries that help to improve the following AIW criteria: • Construction of Knowledge • Deep Knowledge • Critical Thinking Skills • Conversations and Discussion • Elaborated Communication • Value Beyond School
Time Allotment	Between 9 and 11 (45 minutes class period)
Social Studies Practices	Map Reading, Comparison and Contextualization, Graphing, Using Evidence, Geographical Reasoning

(continued)

Table 4 *(cont.)*

Model Topic	World Population Growth
GIS Skills	• Add and find GIS maps • Read a map table and legend • Use Configure Pop-Up tool to create a bar chart • Use GIS analysis tools • 3D imagery • Build GIS layers • Symbology features (e.g. heat maps) • Create a Story Map Journal

Phase One: Selection of Model Components and Theoretical Foundation

The first phase involved selecting GIS Model components to provide clear and organized instruction. The model sought to create a coherent series of lessons to meet the study's objectives which focus upon facilitating AIW criteria through inquiry. The researcher selected the Inquiry Design Model, known more simply as IDM (Swan et al., 2015), because of its ability to offer a visual representation of an entire inquiry and its components, and to clarify the relationships between them. The IDM blueprint presents a one-page snapshot of the inquiries, performance tasks, and the featured sources that define the curriculum inquiry. This helps to organize the short series of lessons and inquiries that will be taught consecutively.

Furthermore, although a review of available academic literature supports the importance of facilitating inquiry in the social studies classroom, there is currently a dearth of empirical literature that focuses upon actually engaging students in inquiry (Grant et al., 2017). Using IDM, however, helps to support inquiry-based practices in social studies classrooms in which the teacher has students use GIS to conduct their investigation. The resulting GIS Instructional Models serve, "…as pedagogically rich examples of content and skills built out in an inquiry based fashion," (Swan et al., p. 316) to facilitate AIW criteria. IDM helps to lead students in smooth transition between inquiries to achieve optimal learning outcomes.

It is important to note that IDM is not a set of lesson plans, or a teaching script, but rather it is intended to be a way of thinking that honors a teacher's knowledge concerning the manner in which they will integrate GIS into their curriculum to support inquiry and facilitate AIW. The IDM blueprint (see Table 3 in Chapter 2) was used as a foundation for developing the model.

Five IDM-related components influenced this design and development research, and there is a brief description of each of them in the following section.

Inquiry principle. The GIS Instructional Model uses two types of inquiry: (a) the compelling question, and (b) supporting questions. The compelling question addresses the key topics, ideas and experiences that students bring to class. It is simply a way to drive social studies inquiry.

The following compelling question drives the inquiry in the GIS Instructional Model: "Is population growth good or bad for human development?" Three supporting questions follow the compelling question to build the scaffolding around it. The inquiry is designed to be logical, interesting and aligned with curriculum standards. The three supporting questions that build around the compelling question are:

Supporting Question 1: How has world population growth changed?

Supporting Question 2: What are the causes of population growth?

Supporting Question 3: What are the consequences of population growth?

Formative performance task principle. Each supporting question has an associated formative performance task, and each of these comprises a short series of activities. These activities were designed to engage students with GIS to demonstrate their understanding and to apply their skills as they complete each specific task to help them answer the supporting question. Moreover, the formative performance tasks also help a teacher to track student progress, allowing them to actively adapt their instructional plans if needed.

Featured sources principle. Featured sources help students to complete the formative performance tasks, which in turn help them to answer the supporting questions. Each formative task requires between one and three disciplinary sources to help students build knowledge and construct their arguments. The featured sources for this model focus upon GIS maps and tools.

Summative performance task principle. Using this principal, students work to construct their evidence-based argument to answer the model's compelling question. The summative performance task helps students to build an argumentative essay. By applying prior knowledge and their GIS endeavors to support their argument, they will answer the compelling question, "Is population growth good or bad for human development?" This activity offers students the opportunity for more exploration, creative thinking, and civic participation.

Taking informed action principle. After students have concluded their inquiries by successfully completing the assigned tasks to answer supporting questions, they will be able to take informed action. In this phase, students engaged with project-based GIS to understand population growth in their country (Kuwait). There are three phases in this activity: (a) Understand - students need to *understand* the phenomena; they will explore how population growth has changed in Kuwait; (b) Assess - students need to *assess* the effects or impact of population growth in Kuwait.; and (c) Act - students have to *act* in ways that demonstrate their role as a responsible member of society; they will make an informed decision about how they can control the population growth in their country. Taking informed action should be directly related to the inquiry (the compelling question).

After following the IDM blueprint to select components for the GIS Instructional Model, the model's structure became clearer. It now only needed filling out with effective GIS activities, inquiries, and sources. Concomitant with model component selection, the researcher also identified the model's theoretical foundation; this helped improve its effectiveness. As already noted, this model encourages students to use GIS as an inquiry tool to facilitate and enhance their AIW. As a result, the researcher selected GIS inquiries, activities and sources that supported the following AIW criteria: (a) construction of knowledge, (b) deep knowledge, (c) critical thinking skills, (d) discussion and conversation, (e) collaboration and communication, and (f) value beyond school. Table 5 provides a brief description of AIW criteria and the GIS Instructional Model objectives.

Table 5

AIW Criteria and the Developed GIS Instructional Model Objectives

AIW Criteria	The Model Objectives
Construction of Knowledge	Students work with GIS to discern meaning and build their understanding when they engage with inquiries (supporting questions).
Deep Knowledge	Students use GIS tools, including analysis and chart-making. They create GIS layers to analyze population growth, determining which countries have the highest population growth rates, as part of the effort to understand and solve problems
Critical Thinking Skills	Students read GIS maps, compare and contrast, use Symbology features to visualize data, use analysis tools, and create their own GIS layers to construct and deepen their knowledge.
Discussion and Conversation	Students discuss GIS efforts with their partner and group members to build an argument and/or evidence-based Story Map.
Collaboration and Communication	Students work on GIS activities with both their partner and their group to create a Story Map. They also use the GeoForm tool to share images with peers.
Value Beyond School	All GIS activities are designed to discover a real world issue. Additionally, students work on a GIS-based project to explore the topic of population growth in their country (Kuwait). Student opinions were also considered.

Phase Two: Analysis and Development

The study's second phase involved analysis and development, which featured the application of the researcher's personal experience along with knowledge gained from reviewing a diverse body of relevant academic literature on GIS instructional tasks and activities (Richey & Klein, 2007). The researcher began the effort to build a GIS Instructional Model by first analyzing and summarizing the GIS lessons and activities which ESRI created for social studies teachers. Table 6 shows the ESRI instructional resources that the researcher used in this phase.

Table 6

Content Analysis: Instructional Resources Provided By ESRI

Lessons	**Subject**		**Lessons**	**Description**
Geo-Inquiries	Geography	Physical Geography	12	GeoInquiries lessons are used here to incorporate ArcGIS Online technology to support social studies content teaching. These lessons include learning objectives, textbook references, formative assessment items, and descriptions of “how-to-do” instructional activities.
		Human Geography	15	
	History	US History	15	
		World History	15	
Mapping Our World	World Geography		20	Mapping Our World lessons are designed for middle school and above to use online mapping. These lessons include activities worksheets and teacher materials.
Total	Social Studies		75	-

The researcher’s personal experiences with GIS and social studies teaching also contributed towards building the GIS Instructional Model. The following, first-person paragraph describes these relevant details related to the study’s creation:

> My undergraduate experience at Kuwait University has enabled me to build a good foundation in social studies education. I have taken a wide variety of courses that have exposed me to a broad array of social studies teaching methods. Following my Bachelor’s degree, I worked as a high school geography teacher for six years. During that time, I maintained a strong interest for integrating new technology into my classroom to facilitate improved student learning. I also have a Master’s degree in geography. While working on my Master’s thesis, I used GIS to test the relationships between dissolved oxygen and other variables such as temperature, salinity and other human factors. The work I did towards my Master’s degree enabled me to work with GIS and learn affordable GIS tools in spatial analysis and geographical reasoning. Following the completion of my Master’s thesis, I found myself interested with applying GIS in social studies classrooms. I have had several experiences regarding the integration of GIS in grade 12 geography classes. My students used GIS to calculate distances and test the relationships between location and temperature, vegetation, and population distributions.

These experiences have been invaluable for my learning new methods and technologies to help improve student learning and skills; experiences I employed to create this model.

A review of ESRI instructional resources, coupled with the researcher's own background and GIS experience, helped to identify the primary components necessary for the development of a GIS Instructional Model featuring inquiries, performance tasks, and featured sources. These elements, aligned with the primary components of IDM, allowed the researcher to systematically develop a GIS Instructional Model for grade 12 social studies classes. This model will encourage students to work with GIS to conduct inquires (about population growth) to facilitate their AIW. The researcher considered ways to improve the AIW criteria discussed in the previous phase throughout the development process.

Phase Three: Formative Evaluation

Phase three consisted of a formative evaluation, via the expert review method, to determine the GIS Instructional Model's ability to facilitate AIW in social studies classes. The expert review method is one of the most commonly used approaches for internal validation exercises to evaluate, modify, and revise a model under test (Richey & Klein, 2007). With this process, experts within the relevant field critique, "…a given model in terms of its components, overall structure, and future use," (Richey, 2005, p. 178). Analysis of their testimony revealed useful information to revise and improve the model. The formative evaluation in this phase sought to determine how well the GIS Instructional Model meshed with AIW criteria, and how this might be improved.

Participants. The purposeful selection method is a technique for choosing study participants based upon their knowledge and its relevance to the endeavor being undertaken (Babbie & Motuon, 2001). The researcher employed such a process in this study, selecting two professional educators for their national reputations within the field of social studies and teaching GIS at the secondary school level. Expert Reviewer 1 is an architect of the C3 framework and a leader in the field of digital technology integration for social studies education. He is an author of several scholarly publications which focus upon inquiry-based practices, the Inquiry-Design Model, teaching the C3 framework, and the use of digital technologies within social studies education. Expert Reviewer 2 is nationally recognized as an exemplary educator, earning this recognition for teaching with GIS at the secondary school level. Expert Reviewer 2 teaches both high school and college courses on GIS. He is well-known nationally for his keynote speeches concerning GIS, and has developed GIS-based curricula for organizations such as ESRI and National Geographic. He has collaborated on a variety of projects that focus upon using geospatial technologies to support social studies instruction, and has received the NCSS teacher of the year award.

Both reviewers have strong knowledge and experience related to this study - their expertise and advice have contributed greatly to both enriching and improving the end product. These experts were tasked with evaluating the GIS Instructional Model's design quality and how well it met its intended purposes. They also provided feedback on how well the model meshed with AIW criteria. The following table provides further detail about these two US Expert Reviewers:

Table 7

The US Expert Reviewers

Name	Career	Institution	Primary Area of Expertise
Expert Reviewer 1	Professor Social Studies Education	University	IDM & Digital history
Expert Reviewer 2	Social studies teacher	High School	Teaching social studies with GIS and Geospatial technologies/ NCSS teacher of the year.

Evaluation protocol. Before beginning the evaluation process, the researcher submitted the study's description and details to the Institutional Review Board (IRB). However, the Virginia Tech IRB determined that their review was not required, because the study did not involve human research (see Appendix A). Following the IRB's decision, the researcher sent invitation emails to potential expert reviewers.

The email requesting an expert's voluntary participation began first by introducing the researcher, and followed with a brief description of the study and its purpose. It then illustrated a reviewer's role, with precise details regarding study protocol. It also explained that the review process consisted of two, roughly hour-long phases: (a) an online survey; and, (b) a follow-up conversation. The researcher also attached a copy of the IRB waiver to the e-mail, and gave each expert two weeks to either accept or reject the request of their involvement. Once an expert reviewer officially agreed to join the study, they received the framework for their participation.

The GIS Instructional Model was located on a website which the reviewers could access to make their evaluations. They then filled in the online survey, with its open-ended questions, and e-mailed the completed document to the researcher. At an agreed-upon time, each reviewer then took part in a follow-up conversation with the researcher to independently elaborate upon their survey responses.

Online survey. Richey and Klein (2007) suggest using predetermined evaluation criteria as a way of determining a study's validity and accuracy. The researcher followed this protocol in testing the GIS Instructional Model; emailing it to each expert with a set of predefined criteria for its evaluation. These evaluation criteria focused upon the GIS Instructional Model's effectiveness in facilitating AIW; namely how well they followed the following six AIW criteria: (a) construction of knowledge, (b) deep knowledge, (c) critical thinking skills, (d) elaborated communication, (e) conversation and discussion, and (f) value beyond school.

The online survey had two parts: evaluation rubric and open-ended questions (see APPENDIX B). The evaluation rubric asked the expert reviewers to assess how effectively the GIS Instructional Model adapted AIW criteria into its activities and inquiry processes. The seven, closed-ended questions in this section had possible response valuations ranging from high to low. The open-ended questions then provided experts with the opportunity to further explain and/or note additional details regarding their evaluation rubric answers.

Virginia Tech's instance of Qualtrics (http://virginiatech.qualtrics.com) administrated the survey. Qualtrics is an online survey tool for collecting data. The expert reviewers received their link to the online survey via email. Once they opened the provided link, they first had to read a consent form. This document explained the study's purpose, its procedures, confidentiality issues, and any participant compensation. It also clarified how the study would use any data obtained from their review efforts, and noted that each person had the right to withdraw at any time. To maintain confidentiality, each participant received a pseudonym; all identifiers were masked as thoroughly as possible (see Appendix C). The expert reviewers had to acknowledge and sign the informed consent form before the software could automatically redirect them to the online survey. Each expert had three weeks to complete their review and provide feedback via the survey. To help keep them on track, the reviewers received an email reminder after three weeks.

Follow-up conversations. The second section of the evaluation protocol included a follow-up conversation via a face-to-face interview. These discussions helped to clarify and expand upon any feedback the experts had provided within their survey responses. The reviewers were also asked to suggest additional activities that might help increase the effectiveness of the model's incorporation of the six previously noted AIW criteria. As a result, new strategies may emerge to better facilitate AIW in the classroom.

Interview protocol. Once the survey phase concluded, the researcher contacted each expert to schedule an interview and location of their preference. Prior to interview commencement, the researcher informed each expert that their conversation would be audio-recorded to ensure the accuracy of information gained through its verbatim transcription (Rossman & Rallis, 2011).

The interviews were semi-structured to collect data, "…in which participants are questioned orally to elicit a detailed description of their perceptions and opinions," (Richey & Klein, 2007, p. 157). The protocol consisted of nine questions that primarily focused upon how the GIS Instructional Model could be strengthened to sufficiently meet the AIW criteria (see Appendix D). Each interview took approximately one hour to complete. The information gleaned from these conversations helped to identify potential weaknesses in the GIS Instructional Model and allow for its improvement. The results from these expert reviews are available in Chapter 5.

Phase Four: Revision

The feedback that experts provide following their model review can help identify its weaknesses, and thereby provide the opportunity for improvements before formal implementation (Richey & Klein, 2007). Indeed, following the expert review in phase three, the researcher devised a plan for how to incorporate formative evaluation findings into the GIS Instructional Model. The following section explains this process.

Data analysis. Analysis began at the onset of data collection and continued through the entire process. Maxwell (2005) states, "The experienced qualitative researcher begins data analysis immediately after finishing the first interview or observation, and continues to analyze the data as long as he or she is working on the research," (p. 95). Accordingly, data analysis began immediately after the reviewers completed their surveys, and continued for the duration of the research effort.

Having feedback from two expert reviewers meant, almost by default, that there were different opinions, suggestions, and views towards the developed model. For instance, one reviewer may suggest improving some model aspects, whereas the other may find them already sufficient as designed. To address this concern, the researcher employed two different data analysis techniques: the analytic memo and the constant comparative method.

With the analytic memo, the researcher recorded their views and perspectives regarding the design and development phases for each of the AIW criteria. These memos helped track the researcher's thoughts and ideas contemporaneously as they emerged throughout the research endeavor. Writing an analytic memo will, "…not only capture your analytic thinking about your data, but also facilitate such thinking, stimulating analytic insights," (Maxwell, 2005, p.96). Using the analytic memo technique allows a researcher to potentially see a pattern emerging in the data as it is being recorded, helping to summarize major findings during model evaluation. Figure presents an example of analytic memo. Figure 5 prensents an example of analytic memo.

Theme: Supporting Materials

Critical Questions: "Why is adding supporting materials important? What types of materials are required? How do we add them?"

Once I started analyzing the survey, I realized that the model lacked supporting materials. Expert Reviewer 2 stated that "The support materials to help teachers and students develop deep knowledge about population growth is limited." Some questions were raised concerning the "type of materials", and I decided this was what I should focus on in the interviews. After conducting my interviews, I concluded that both experts alluded to the importance of adding supporting materials in the model. As I worked with social studies teachers for six years, I know the importance of supporting materials to facilitate teaching. I think if I add all necessary materials, the model will be clearer and easier to implement. It is important to understand what materials I should add. Expert Reviewer 1 stated that "There has to be some structure shuffled in place, like directions." He found teachers may not know how they can implement this model because there were no directions. I agree that the model lacks instructions, the model provides general descriptions of the model without instructions about how they can do these exercises. I think I need to describe each exercise very well with instructions. For example, I can provide step-by-step instructions describing for teachers what they should do, allocating time for each exercise, and listing the materials needed to prepare. All these will help them to understand the model and facilitate their implementation. Moreover, Expert Reviewer mentioned that all materials should be attached with activities, the materials should be well-organized and well-presented not "scattered", and I should not write teachers have to develop instructions or something like that. The unit should be introduced with all necessary materials and the teacher should find the unit is ready to teach with

Figure 5. Screenshot of analytic memo example.

With the constant comparative method (Glaser & Strauss, 1967), the researcher compares each data element with other relevant data (Merriam, 1998). In the first step, the researcher read the data for each expert reviewer and coded it individually using the predetermined criteria shaped around the essential AIW themes already discussed. For the second step, for each criterion, the researcher compared the coded data derived from one expert reviewer with the relevant coded data from the other; this helped define similarities and differences between expert reviewer responses, and thus revealed a comprehensive understanding for their evaluation feedback (see figure 6).

Theme	Comments	Expert Reviewer 1	Expert Reviewer 2
Students deep knowledge about the population growth topic	Survey Rubric	Medium	Medium
	Survey open-ended questions	"The unit does not really support a critique of systems that support or limit population growth." "There are limited economic factors being explored."	"I was surprised that your Introductory activity on Kuwait did not utilize GIS. I think this would be a great activity to use to introduce students to the following questions: What is GIS, How does GIS work? Why use GIS? What does GIS tell us about Kuwait?"
	Interview	"I would like to see some attention to economic issues, and perhaps a consideration of some of the critique of population growth" "Perhaps calling into question assumptions about zero population growth"	"I feel like it needs to be here turn online or what is GIS what these things are and help introduce that in scaffold than introduction."… "you maybe the studies they have a couple of just great story map on what is development and tell us with either the maps we have shared with you and they can pick from those maps and are you familiar with map journal where you can choose the content that shows" "If you can find some information that shows how the Arabic world or the middle east differs in development of indicators"
	Conclusion	Students need to learn about: • Economic factors • Information about minus and zero population growth	Expert indicated two main points: • Introductory activity could be a story map that introduce students to unit key concept such as GIS, population growth, and development. • Students needs to learn about development topic

Figure 6. Screenshot of constant comparative data analysis.

In summary, writing analytic memos, while also employing the constant comparative method, heightened the researcher's critical thinking regarding decisions about what model features required revision and improvement.

Phase Five: Usability Evaluation

The primary purpose for this phase was to discover any potential barriers to the GIS Instructional Model's classroom implementation, and to identify where additional development might be needed. The researcher selected six Kuwaiti expert reviewers to determine how adequately the proposed GIS-based Instructional Model was prepared for fielding in a Kuwaiti classroom, and what problems to expect from its application. The researcher selected expert reviewers based upon the following specific criteria: They must have; (a) real-world experience in applying digital technologies within grade 6-12 classrooms; (b) a minimum of ten years teaching social studies within grade 6-12. Each of these experts is acquainted with the researcher to some degree, either from common experiences in Kuwait while teaching or when studying at university, but this is not why they were chosen. The researcher contacted the head of social studies at her former school in Kuwait, and requested a list of teachers whom would both be willing to participate in the study and also met its selection criteria. The department head suggested three teachers who fit the profile; all of them former colleagues of the researcher (T3, T4, and T6). The other three experts whom participated (T1, T2, and T5) were former university classmates of the researcher. While the Kuwaiti expert reviewers were all social studies teachers, they came from four different high schools. Table 8 provides some of their relevant details.

Table 8

Kuwaiti Expert Reviewers

Expert	Gender	Experience (years)	Education Level	Subject	School	Grade(s) Taught	Works with GIS	Applies GIS in Classroom
T1	F	10	BSc Education/Geography	Geography	High School	10 & 12	NO	NO
T2	F	14	BSc Education/History	History	High School	10	NO	NO
T3	F	10	BSc Geography	Geography	High School	11	YES	NO
T4	F	17	BSc Geography	Geography	High School	11 & 12	YES	NO
T5	F	11	BSc & MSc Geography	Geography	High School	11 & 12	YES	YES
T6	F	21	BSc Education/Geography	Geography	High School	12	NO	NO

The social studies teachers who participated in this phase are divided into two groups: those with a bachelor's degree in education (with a specialization in either geography or history) and those with a geography degree from the Social Sciences College. Three social studies teachers have prior experience with GIS, while the other three have not worked with GIS before. One of the participants has applied GIS in the classroom. Chapter 5 will discuss the participants' experience and background in detail.

Evaluation protocol. The researcher contacted each potential expert reviewer by telephone, to enquire about their interest in taking part in the study. Following their verbal acceptance, the researcher emailed each participant a description of the study, a consent form, the final version of the GIS Instructional Model, and the survey link. The survey investigated the following question, "How easy will it be to integrate and use the GIS Instructional Model in Kuwaiti social studies classrooms?" Nearly two weeks elapsed before the researcher received all of the completed surveys.

The survey began with a section concerned with usability rubric; the researcher asked the experts to determine the level of difficulty a teacher would likely experience while employing the GIS Instructional Model in a social studies classroom. The factors which the reviewers had to consider included: (a) information technology infrastructure; (b) time - both instructional and preparation; (c) teacher preparedness, and; (d) potential barriers in curriculum structure and policy. The following text describes these factors in more detail:

(1) Time: This refers to the time required to implement the GIS Instructional Model and comprises two subsets: (1) instructional time; and (2) preparation or practice time. 'Instructional Time' describes the amount of time which a teacher needs to implement the GIS Instructional Model in class - i.e. the number of class periods it will take to teach. 'Preparation Time' is time spent outside of class which a teacher spends preparing class materials, technological devices, a computer lab, etc. It also includes time a teacher invests in learning/refreshing GIS and IT skills, practicing model implementation, etc.

(2) Information Technology (IT) Infrastructure: This refers to the basic facilities and equipment required for a teacher to implement the GIS Instructional Model; it comprises the technological devices (computers, laptops, tablets and/or smart phones), software, network connections, electricity, etc.

(3) Teacher Preparedness: This describes the extent to which an in-service teacher's skills and background prepare them to implement this model. More specifically, it explores the readiness of social studies teachers in Kuwait to both use GIS and implement this model in their classrooms.

(4) Curriculum Structure and Policy: This factor seeks to explore the flexibility of Kuwait's social studies curriculum to facilitate the implementation of this model. In other words, it endeavors to measure the level of centralization and standardization of Kuwaiti social studies curriculum and the resultant effects upon integrating GIS in classrooms.

The survey then asked the experts open-ended questions regarding the above four factors, and any perceived difficulties these factors may create to hinder model implementation (see APPENDIX E). The expert reviewers were also asked for suggestions which might improve the model for incorporation in future Kuwaiti social studies curricula.

Data analysis. Once the Kuwaiti expert reviewers completed the survey, the researcher analyzed the resultant data. The researcher read the data for each expert reviewer, coding it individually using the above-named predetermined criteria shaped around the essential barriers to the model's implementation in the Kuwaiti educational system. The researcher employed the constant comparative method to analyze the expert reviewers ’feedback. With the constant comparative method, the researcher compares each data element with other relevant data under each theme.

In the first step, the researcher read the data for each expert reviewer and coded it individually using the predetermined criteria shaped around the following four factors: (a) instructional and preparation time; (b) IT infrastructure; (c) teacher preparedness; and (d) curriculum structure and policy. In the second step, the researcher compared the coded data, for each factor, derived from one expert reviewer with the relevant coded data from the other; this helped define similarities and differences between expert reviewer responses, and thus revealed a comprehensive understanding for their evaluation feedback. The researcher then identified the essential views and suggestions for each factor, incorporating them into the findings (see figure 7).

	T1	T2	T3	T4	T5	T6
Time	Negative " No time is not enough because students may need more time to achieve works as this the first time to use GIS" "Students may need more time to understand how it works, as this is the first time they will use GIS." suggestions: ""teacher should expect this model need longer tim and think that there many ways to fix time by removing or reducing some activities so teacher should create a plan about what activities will remove or reduce time"	Positive "the model is flexible in order to reducing activities"	Negative "we need time to practice even though I have experience in GIS following the instructions and practice before implementing will take too long time, and time to teach students to use GIS" Suggestions: "we should think about if we face some technical issues, we need someone has experience in technical issue is required to help teachers if they face problems".	Positive "In general, the grade 12 textbook is short, and the time always is excessive. We always have additional times to give students feedback and do more exercises. I think yes we can apply this model"	Positive "In general, the grade 12 textbook is short, and the time always is excessive. We always have additional times to give students feedback and do more exercises. I think yes we can apply this model"	Negative "no the time not enough because the model is long No suggestions

Figure 7. Screenshot of constant comparative data analysis of usability feedback.

Quality of Research

The validity and reliability of results determine the quality of quantitative studies. However, quality is harder to characterize for qualitative studies, because the researcher does not use instruments or statistical data that definitively measure reliability and validity. It is therefore important to identify how the qualitative researcher establishes the validity and reliability of the study's findings (Lincoln & Guba, 1985). For this study, the researcher used two steps to measure its quality: triangulation and open-ended questions.

Triangulation involves using multiple data sources to produce a more comprehensive understanding of the problem (Merriam, 1995). For this study, data from the online survey and follow-up interviews facilitated a deeper understanding of the issues involved with designing an accurate GIS Instructional Model and integrating it into Kuwaiti social studies classrooms.

Asking open-ended questions provides detailed descriptions regarding the extent to which a model's conclusions are transferable to other settings and times (Lincoln & Guba, 1985). As such, the researcher used open-ended questions to review the GIS Instructional Model with Kuwaiti experts and to evaluate the possibility of applying it in Kuwaiti secondary school social studies classrooms.

Chapter Summary

The chapter described the methods used to design, develop, and validate the GIS Instructional Model. The chapter addressed the following areas: (a) the research purpose and questions, (b) the research design, (c) developmental study procedures, and (d) the quality of research. Through the developmental study procedures section, the study participants as well as data collection and analysis procedures were described. Chapter 4 will present the final version of the GIS Instructional Model.

CHAPTER 4
THE DEVELOPMENT OF THE GIS INSTRUCTIONAL MODEL

The purpose of this study is to design, develop, and validate a GIS Instructional Model for social studies teachers to facilitate AIW in their classrooms. Indeed, the developed model seeks to resolve the fundamental question of "*how a GIS Instructional Model can be designed pedagogically to facilitate inquiry and AIW in social studies classrooms?"* To answer this question, the study employed Type 1 design and development research with the following phases: (a) selection of the model components and theoretical foundation, (b) analysis and development, (c) formative evaluation, (d) revision, and (e) usability evaluation. The model was developed from a literature review and researcher experience during the analysis and development phase, and followed IDM components and principles. The theoretical foundation for this model comes mainly from the AIW framework. Thus, the evaluation criteria focused upon how disciplined inquiry facilitate the six AIW criteria: (a) construction of knowledge, (b) deep knowledge, (c) critical thinking skills, (d) elaborated communication, (e) discussion and conversation and (f) value beyond school. To ensure its quality, two social studies teaching experts reviewed the model and, as part of their evaluation, gave advice for how it could be improved. As part of this effort, the expert reviewers filled out an online survey, and took part in follow-up conversations. The online survey was structured to help determine any areas of weakness in the model and to identify potential solutions. Follow-up conversations allowed the experts to expand upon their survey responses, and to suggest techniques for improving the model.

This Chapter shows the final version of the GIS Instructional Model that resulted from modifications made during the revision phase (after having first completed the formative evaluation phase). To help readers keep track of these alterations, *added* elements are identified with an asterisk (*), while *revisions* are footnoted. For completeness, the original GIS Instructional Model is included in Appendix G; revised activities are presented using a blue font. Details behind the reasons for making these changes, and how they were effectuated, are delivered in Chapter 5.

This chapter is divided into three parts: (a) an overview of the GIS Instructional Model, (b) Model revisions, (c) The final version of the GIS Instructional Model. The chapter starts with an overview of the GIS Instructional Model, which provides a general description of the model.

It discusses the form of the model, the topic the model addresses, the subject, and the grade level. It also describes how the GIS Instructional Model will fit into the social studies curricula in Kuwait, the time allocated to it, and which GIS application will be used in the model. All this information is necessary to understand the general overview of the model before discussing its components in detail. Before reviewing the final version of the GIS Instructional Model, it is important to review the model revisions that were made by US experts. This part provides a brief description of expert reviewer feedback, suggestions, and recommended revisions to assist the reader's understanding of the changes that were made as they read this chapter. The last section presents the final GIS Instructional Model that will result from the formative evaluation phase. It discusses the GIS Instructional Model inquiry, and its components with all required materials.

Overview of the GIS Instructional Model

The GIS Instructional Model follows the IDM components, principles, and format. It explores the world population growth topic, with a curriculum that comprises less than a unit in size, but more than a lesson. The population growth topic, in fact, is the first topic in the population geography unit within present Kuwaiti geography curricula. In this population geography unit, students learn about: (a) population growth; (b) population movement and distribution; and (c) population density. In Kuwait, social studies teachers currently rely mainly upon textbooks and paper maps for their instruction of this unit. While the existing Kuwaiti Grade 12 geography textbook contains a chapter on GIS, it unfortunately focuses solely upon information *about* GIS, rather than its *implementation*. As such, social studies teachers can only direct students to learn about GIS - its definition, components, and advantages - through memorization techniques, rather than direct use. This may be beneficial as a first step towards implementation but, so far, GIS has not enjoyed wide use as part of social studies instruction in Kuwait. To address this issue, the GIS Instructional Model seeks to revise the population growth topic to incorporate GIS and provide a practical example for how students can learn social studies topics *with* GIS.

Kuwaiti schools are at least starting to introduce computers into the classroom, which will make it easier to integrate GIS into social studies instruction. As already noted, the GIS Instructional Model's objective is to show how the technology could be integrated within teaching practices to support student inquiry and AIW. In this model, social studies teachers encourage students to work with GIS to explore, analyze, and make decisions in a spatial manner instead of using traditional methods that focus on recitation techniques. It focuses on teaching *with* GIS, and more specifically, upon conducting *inquiry* with GIS, rather than simply learning how to use the technology.

The overall population geography unit usually takes from twelve to fourteen 45-minute class periods, which take place over approximately one month. Roughly half of the unit represents the population growth topic, while the rest covers population distribution and density. In this case, the model is designed for use in geography instruction at a Grade 12 level and should take from nine to eleven 45-minutes class periods to complete.

Some social studies teachers may feel that this model's class-time requirements are too demanding, that there wouldn't be enough teaching time available for them to justify integrating the model into their curricula. However, there are some options available that could mitigate this potential dilemma. Teachers could adapt the model to fit their own instructional timeline by reducing the time set aside for some specific model tasks, for instance, or reducing the activity load. Teachers could also ask students to complete some elements as homework, such as the peer review activities for the supporting questions. Another method, although more substantive, could involve making changes to the geography textbook to integrate this model within grade 12 geography curricula. For example, the textbook publisher could replace the GIS chapter with a short description of GIS instead of an entire chapter. Teachers could then begin their semester with this brief GIS overview, and then integrate the technology into their instruction that follows from the rest of the textbook. Via this option, students would gain information *about* GIS, and then work *with* GIS activities to discover the geographical topics in the textbook. Teachers should also note that the difficulty level for GIS activity ranges from beginner to intermediate. Each task/activity comes with a worksheet and guidance instructions to provide teachers with details about how they could guide students in their efforts with GIS to perform geographic inquiry and facilitate AIW criteria.

This model uses three ESRI applications: ArcGIS Online, Story Map, and GeoForm. ArcGIS Online features internet web maps that provide the opportunity to interact with multi-layer maps easily and quickly. It provides the basic tools to perform analysis and spatial representation of data. Students can access ArcGIS Online easily from many devices including laptop computers, tablets and even smartphones. Students can also publish their work and share it with others. The second application, Story Map, provides a collection of templates to combine maps with appropriate descriptions for presenting final reports. The third application, GeoForm, allows students to insert data via a form in Web Map and share these data with others. In this model, students will engage in these three applications to create maps, analyze data and present their findings.

The Model Revisions

Feedback from the US expert reviewers helped to determine the model's weaknesses and provided suggestions for improvement, some of which lead to revisions. While this section does not include a comprehensive explanation for each revision, there is an overview which will assist a reader’s understanding for the changes as they read this chapter. These changes came as either added materials, or revised activities. In all, eleven changes were made to the original GIS Instructional Model, and four types of material were added. These four material types comprised the following:

1. Materials Box: The researcher compiled a box of ready-to-use materials (See Appendix F) to accompany the final GIS Instructional Model. This includes step-by-step instructions for the students and the worksheets they need to complete their tasks.
2. Procedures for Implementation: The researcher added ‘procedures for implementation’ for each task to provide teachers with the essential steps they need to follow as they apply the model.
3. Physical classroom environment description: The researcher added a paragraph describing the recommended physical environment for the classroom to enable the model’s successful implementation.
4. Added peer evaluation activities. Couple of peer evaluation activities were added to help students share their work with others and exchange feedback to collectively improve their work.

As noted earlier, elements added to the model are identified with an asterisk (*), while revisions are footnoted from 1 to 11. Table 9 provides an overview for these model revisions.

Table 9

Overview of Model Changes

Changes	Part	Expert Reviewer	Description of Change
1	GIS Instructional Model blueprint	Expert Reviewer 1	Revising performance tasks, and table organization.
2	Staging of the Compelling Question Task	Expert Reviewer 2	Replacing this task with story map activity to introduce students to model's key concepts.
3	Supporting Question #1, fourth activity (Analysis)	Expert Reviewer 2	Students will use the analysis tool to discover countries that will have populations in excess of one billion in 2050 instead of just exploring the GIS layers.
4	Supporting Question #1, final activity (Act)	Expert Reviewer 1 & Expert Reviewer 2	Students will use the Story Map (journal format) instead of using the Cascade format.
5	Supporting Question #2, second activity (Acquire)	Expert Reviewer 2	This activity changed to achieve the following goals: (1) Students will use the Symbology feature to convert infant mortality rates into a heat map instead of creating a bar chart. (2) Students will explore infant mortality, fertility, and life expectancy rates in different scales instead of focusing on country level.
6	Supporting Question #2, third activity (Explore)	Expert Reviewer 2	Students will use the Symbology feature (counts and amounts) to compare between population growth and birth and fertility rates. They will also use the search bar and add map notes instead of just comparing between GIS layers.
7	Supporting Question #2, fourth activity (Analysis)	Expert Reviewer 2	This activity changed to achieve the following goals: (1) Students will build their own GIS layer instead of comparing between GIS layers.
		Expert Reviewer 1	(2) Students will explore the relationship between health expenditure, poverty and literacy rates and population growth instead of just exploring the relationship between literacy and population growth.
		Expert Reviewer 1	(3) Students explore the previous factors in high, low, minus, and zero population growth instead of just focusing in high and low population growth.
8	Supporting Question #2, final activity (Act)	Expert Reviewer 1	Students add slides on their map journal instead of creating a mind map.

(continued)

Table 9 *(cont.)*

Changes	Part	Expert Reviewer	Description of Change
9	Supporting Question #3, fourth activity (Analysis)	Expert Reviewer 1	This activity changed to achieve the following goals: (1) Students analyze the relationship between population growth, economic growth and poverty
		Expert Reviewer 1	(2) Students address the previous consequences in high, low, negative, and zero population growth instead of in high and low population growth.
		Expert Reviewer 2	(3) Students create their own GIS map instead of comparing between GIS layers
10	Summative Performance Task	Expert Reviewer 1	This activity was revised to be a discussion-based activity instead of just using previous work to build an argument.
11	Take Informed Action	Expert Reviewer 2	This activity changed to achieve the following goals: (1) Students will complete this activity by working with ArcGIS Online instead of ArcMap. (2) They will also use the GeoForm app to insert their own pictures and share them with peers.

Final GIS Instructional Model

The researcher created the GIS Instructional Model with the intention of it being a ready-to-implement tool that enables social studies teachers to smoothly integrate GIS into their classroom instruction in an effective way. The following section shows the final version of the GIS Instructional Model that resulted from the revision phase. The GIS Instructional Model follows the IDM blueprint and format in a systematic process. Each IDM principle within the model is described; guidelines, with the required materials, are also provided. It is important to note at this point that a teacher's implementation of this model may vary based upon their educational goals and the interests they have for their class; i.e. teachers can adjust the model to work for them as needed. Table 10 displays an overview of the GIS Instructional Model; subsequent sections will show the model itself.

Table 10

GIS Instructional Model Blueprint[1]

<table>
<tr><td colspan="3">Compelling Question: Is population growth good or bad for human development?</td></tr>
<tr><td>Staging the Question</td><td colspan="2">Explore the story map journal with the graphic organizer to identify the key concepts of this inquiry such as GIS, population growth, and human development (in group work).</td></tr>
<tr><td>Supporting Question 1</td><td>Supporting Question 2</td><td>Supporting Question 3</td></tr>
<tr><td>How has the world’s population changed over time?</td><td>What are the causes of rapid population growth?</td><td>What are the consequences of rapid population growth?</td></tr>
<tr><td>Formative Performance Task</td><td>Formative Performance Task</td><td>Formative Performance Task</td></tr>
<tr><td>Use GIS tools (e.g. timeline bar, configure pop-up, and analysis) to identify how the population has changed with time and location, and create a story map journal to demonstrate work and answer supporting question.</td><td>Compare multiple layers in GIS maps using Symbology features. Build your own GIS layer to demonstrate the causes of rapid population growth. Add slides to your journal to show work and answer the supporting question.</td><td>Add GIS maps on a 3D imagery scene. Create your own GIS map by adding points, creating an attribute table, using Symbology features to understand the consequences of population growth and adding slides to your journal to show work and understanding for the supporting question.</td></tr>
<tr><td>Featured Sources</td><td>Featured Sources</td><td>Featured Sources</td></tr>
<tr><td>Source 1: World Population Growth Map
Source 2: Global Population Change in the 21st Century map</td><td>Source 1: World Bank - Age and Population map
Source 2: Infant Mortality Rate map
Source 3: websites listed below
- https://www.latlong.net/
- https://data.worldbank.org/
- https://google.com</td><td>Source 1: Tree Cover Loss map
Source 2: Population Density map
Source 3: website listed below
https://data.worldbank.org/</td></tr>
<tr><td>Summative Performance Task</td><td colspan="2">ARGUMENT Is population growth good or bad for human development? The argument activity will be a discussion based activity (work in groups) to construct an argument that addresses both the positive and negative sides of population growth using specific claims and relevant evidence from GIS maps while acknowledging competing views. The argument will be created in a story map format.</td></tr>
<tr><td>Taking Informed Action</td><td colspan="2">UNDERSTAND Create a GIS map that shows how the population has changed in Kuwait, as well as the causes and consequences of this growth
ASSESS Create an action plan to manage population growth in Kuwait.
ACTION Write an e-mail to a policymaker to propose changes in highly populated governorates to help accommodate future growth</td></tr>
</table>

[1] Two changes were made to the IDM blueprint: (a) the organization of model components, and (b) performance tasks. You can see the original draft in Appendix G.

Inquiry Description

This inquiry leads students, using GIS, to work through an investigation into rapid global population growth, and the planet's ability to sustain it. It should enable students to use GIS technology to help them think like a demographer in finding ways to manage the rate of this change. The question,“ Is population growth good or bad for human development?” opens the argument, and invites students to determine both its positive and negative aspects. Student answers may vary due to several factors, such as the country which is under scrutiny, its population growth rate, and even a student's own cultural background and beliefs. Some may see population growth as being good for business and economic development, whilst others might be more concerned with the associated environmental problems and limited available resources. The arguments between these differing perspectives will provide students with knowledge and insight to evaluate either side of the debate. Through their pursuit of this inquiry, students should be able to work with GIS to make decisions about future global population growth.

Students will learn to work with GIS to discover trends in global population growth, analyze the causes and consequences, and explore how they affect their own nation. As part of learning about population growth, students must engage in various GIS-related activities. These will include finding and adding data, visualizing these data (e.g. Symbology), creating charts and maps, and using analysis tools to understand population growth topics. They will then follow a logical process to support their claims by working with GIS to gather evidence and link their findings to the debate. The summative performance task asks students to synthesize what they have learned from previous GIS tasks to construct their own arguments, while supporting them with evidence. Additionally, the search for answers will open class discussion, and allow students to share their perspectives.

It is important to note that this inquiry will require students be able to work with GIS to build their own understanding for population growth, so teachers must think about how it will help them to work with GIS to construct this knowledge. Students will use GIS during every step of this inquiry. They will initially explore the meaning of population growth and which countries have the largest and smallest numbers of people. In the second Formative Performance Task, students will learn the causes behind population growth. In the third task, students will analyze the consequences of overpopulation. Through their efforts to complete these tasks, students will acquire the GIS skills necessary to build sufficient knowledge to construct their argumentative essay about population growth. In addition to the above tasks, teachers should consider how best to prepare their students for the real world beyond the school's walls. The inquiry must therefore raise student awareness about global issues and encourage them to anticipate addressing these problems, and others like them, as they assume their responsibilities as citizens of the world.

Students will work with GIS to analyze, compare, contrast, and make informed decisions about the population growth topic in the inquiry, which is designed to align with AIW criteria. To answer the Compelling Question, students will construct their knowledge by following three sub-inquiries (Supporting Questions). Students will work in pairs and in groups to provide them with the opportunities to build shared knowledge and communicate with their peers in exchanging ideas and information. Collaborative work helps students to improve their knowledge and enables them to discuss and share their thoughts with others.

Content, Practices, and Literacies

In combination with evidence from their previous GIS activities, students will engage with a series of Supporting Questions, Formative Performance Tasks, and Featured Sources to construct an argumentative essay to address the Compelling Question:“ Is population growth good or bad for human development?”

The Supporting Questions and Formative Tasks introduce students to documents discussing changes in population growth, the associated causes behind these changes and how they affect the world. A Formative Performance Task explains the GIS activities which students must complete in order to answer a given Supporting Question. These tasks will engage students heavily with ArcGIS Online. GIS software has the powerful ability to enable students to investigate phenomena from a spatial perspective. Students will learn about the geographical location under investigation, and how that region's particular characteristics will influence lives in the local population, and perhaps even those further afield. Simply put, ArcGIS Online provides students with a foundation for geographic thinking.

Throughout the inquiry, students are asked to complete three Formative Performance Tasks to build their knowledge and develop skills to answer Supporting Questions. Initially, students are asked to use GIS tools (e.g. timeline bar, configure pop-up, and analysis) to gain understanding for GIS maps and to identify how a population has changed over time in the region under investigation. The second task asks students to compare between multiple layers of GIS maps using the Symbology features, and to build their own GIS layer to illustrate the causes of rapid population growth. In the third task, students will add GIS maps to a 3D scene, and create their own GIS map by adding points, creating an attributes table, and using Symbology features to gain understanding for the consequences of population growth. Finally, in the Summative Performance Task, students will engage in a discussion to help them write an argumentative essay that explains the varying perspectives regarding the effects of population growth, supporting their arguments with the evidence and sources used throughout their earlier inquiry.

The creation of Supporting Questions and Formative Tasks is based upon the underlying criteria established by AIW. Supporting Questions are designed to be logical, and the sequence of Supporting Questions should enable students to construct their knowledge about global population growth. The Supporting Questions must also be relevant to real world issues. The inquiry is intended to facilitate the construction of knowledge, collaboration between students, and the development of communication skills. The Formative Performance Tasks must also consider real world issues and be relevant to student lives. In summary, by using IDM and the tenets of AIW to guide the creation of our GIS Instructional Model, teachers will maximize the benefits of using GIS in social studies classrooms.

Physical Classroom Environment*

Preparing the classroom environment for teaching this model is a logical starting point towards its implementation. There are several factors that should be considered to maximize student learning opportunities and engagement; these include the following:

Physical setting. As this model encourages collaboration, students should be arranged in small groups. Teachers may organize them in clusters of desks to facilitate group work and discussion, however, it is essential to make sure that all students are within clear eyesight of the teacher, and vice versa. Each group should contain from four to six students which will help them engage one another in discussion, but without overcrowding. The students within each group should be of varying ability, but it is important that those whom are strongest academically should intermingle with their teammates.

* Physical classroom environment part was added.

Time. This inquiry is expected to require from nine to eleven 45-minute class periods to complete, although this may be expanded if a teacher feels that their students need more time. Teachers should also feel free to modify the model to meet their learning objectives.

Materials and supplies. To implement this model, teachers will need at least a dozen, web-accessible communication devices for class-members to work with. This may mean students will have to bring their own smart phone, tablet device, or laptop computer to use, but the teacher should provide school equipment if it's available. If necessary, the school's computer lab could be used to implement this model, although the class's physical setting may need to change as a result. And of course, an efficient Wi-Fi connection will be essential for students to use the ArcGIS Online website. Students will also need to create their own ArcGIS Online account before starting this inquiry. All of the required class material (instructions, worksheets, and activity details) are attached with this model; they only need prepare them ahead of each teaching period.

Teachers should prepare the physical classroom environment to facilitate the implementation of the GIS Instructional Model. There are a couple of instructions that should be followed, which clarify the class preparation. Teachers will follow the instructions below before the implementation. Classroom management instructions:

1. Reserve the school's computer lab in advance, or prepare digital devices (laptops, tablets, or smart phones).
2. Ensure the availability of a reliable, high-speed internet connection for students.
3. Prepare the required worksheets either by printing hard copies for the students, or uploading the worksheets for online use.
4. Adhere to the time allotted for each activity.
5. Split students into small groups, with each group having team members of varying skill sets and abilities. Within each group, divide the students into pre-determined pairs.

Explanation of Model Components

This section provides detailed descriptions for the model components shown in Table 10. There are four major components: (1) Staging of the Compelling Question; (2) Supporting Questions with Formative Performance Tasks and Featured Sources; (3) Summative Performance Task; and (4) Taking Informed Action. Each component is described for social studies teachers, along with details for how they could implement it in their classroom (with all of the required materials included in Appendix F).

1. Staging of the Compelling Question

The staging of the Compelling Question is an introductory activity that acquaints students with the model's Compelling Question: "Is population growth good or bad for human development?" In this activity, students should gain the basic foundation of knowledge concerning the concepts of population growth. This section is not intended to answer the Compelling Question, but serves instead to provide students with an overview of the model topic and indeed the question itself. Table 11 includes a brief description of the model's staging of the Compelling Question activity.

The Compelling Question," Is population growth good or bad for human development?" asks students to understand the relationship between population growth and human development, while assessing the potential future effects of global population growth. To prepare students for this inquiry, teachers need to provide an overview of the model topics, the relationships between key topics, as well as definitions for essential concepts used throughout the inquiry.

Table 11

Staging of the Compelling Question Description

Compelling Question	Is population growth good or bad for human development?
Lesson Overview	This lesson will use GIS technology and the story map app to introduce students to the Compelling Question: "Is population growth good or bad for human development?"
Time	One 45-minutes class period
Learning Objectives	Students will be able to explore the story map to: (a) identify the concept of GIS, how it works, and why it's important. (b) define the population growth and human development concepts, (c) demonstrate knowledge of how population growth differs spatially (e) examine the relationships between population growth and development.
Materials*	Material A: Story Map: https://arcg.is/0GumvS Material B: Story map graphic organizer worksheet

* Materials were added, and represented in Materials Box in Appendix F1.

There are three main goals in the staging of the Compelling Question task. The first objective is to create a foundation of knowledge that provides students with basic information about GIS, how it works, and why it is important. After completing this task, students will be able to understand what GIS maps are, and how they work. Secondly this task will help students to use GIS maps to understand the population growth rate and human development index, and how population growth is temporally and spatially different across the world. For example, students will recognize that population growth rate and human development indices differ from nation to nation, and that each country has different experiences. Finally, students will discover that there is a relationship between population growth and human development. They will also have the opportunity to briefly examine this relationship.

To achieve these goals, students will engage with a story map journal and graphic organizer sheet (see Appendix F1). The story map journal contains seven slides. Each slide has links that direct students to relevant images, GIS maps, articles, or video. The graphic organizer sheet has directions for student interaction with these links, and also includes questions that they have to answer. Students must read the directions and follow the links in order to complete the required activities and answer the questions on the sheet. Students will work with a partner for all but the last slide. This last slide comprises the closure activity, featuring an open discussion in which students will debate (within their groups) the relationships between population growth and human development. Students should not feel forced to answer the Compelling Question definitively; they should learn that population growth rates vary from nation to nation, so the correct response will not always be obvious.

Table 12 provides an overview of the activities involved with the story map journal slides in the staging of the Compelling Question task.

Table 12

Staging Compelling Question Task Activities

Slide	Question	Activity
1	Introduction	• Read the slide
2	What is GIS? What are the components of GIS? What are the differences between a paper map and GIS map?	• Read a definition of GIS. • Show image depicting GIS components • Compare a GIS world population map with its paper equivalent.
3	What is the importance of GIS? What are the five steps needed in applying GIS to solve problems?	• Watch a video about the importance of GIS. Read about how GIS works.
4	What is the population growth rate?	• Explore the GIS population growth map. • Read about population growth.
5	What is Kuwait's population growth rate? What is the range of population growth rates across nations in the Arabian Gulf? What is the world population growth? Is Kuwait's population growth rate higher or lower than the globe's? What do you note?	• Investigate the population growth rate map in different scales: Kuwait, the Arabian Gulf, and Arabian countries. • Compare population growth rates between Kuwait and other Arabian Gulf countries. • Compare population growth rates for nations in the Arabian Gulf and those for other Arabian states. • Compare the Kuwaiti population growth rate to that of the globe.
6	Where are areas of high HDI located? Examples? Where are areas of low HDI located? Examples? What is Kuwait's HDI? What are the HDI for Arabian Gulf countries? What do you note? What is the average global HDI? Is Kuwait's HDI higher or lower than the global average?	• Explore the Human Development Index (HDI) in the world GIS map. • Using the GIS map, explore the HDI across different scales: Kuwait and the Arabian Gulf. • Compare HDI between Kuwait and other Arabian Gulf countries. • Search for the global average HDI.
7	**Closure:** Is there a relationship between population growth and human development? How so?	• Group discussion to answer: "Is there a relationship between population growth and human development? How so?"

To hook students into the staging of the Compelling Question task activities, the teacher will ask students to access the story map journal by clicking the following link: https://arcg.is/0GumvS (see screenshots of the story map journal in Appendix F1-Material A). Students will interact with this story map journal and answer the questions listed on the story map's graphic organizer worksheet (see Appendix F1-Material B). The following section describe the story map journal slides and associated activities:

Slide 1: Introduction. This slide has a brief description about the Story Map Journal, its contents and its purpose. In reading this slide, students will learn that the map journal is designed to engage them with exploring GIS, population growth, and human development topics.

Slide 2: Geographic Information System (GIS). This slide provides students with essential information about GIS. Students will learn what GIS actually is, what components it comprises and the differences between a GIS map and a paper map. Students will initially visit two different links; one showing an image of a paper map and the other, a GIS map. Comparing between these two maps, students will answer the first question on the graphic organizer sheet: "What are the differences between a paper map and a GIS map?" They will then click on another link to read a brief National Geographic article that describes GIS while also featuring images of GIS map layers. Reading this article will enable students to answer the graphic organizer's second question," What is GIS?" Students will then click on a link to view an image that illustrates the GIS components, and conclude their work on this slide by answering the question, "What are the components of GIS," on the graphic organizer sheet.

Slide 3: The Importance of GIS. This slide will help students to understand why GIS is important. It contains two links. The first of these features a web-page describing how GIS works; there is a brief synopsis for how GIS is used in a decision-making process or for solving a problem. After reading this page, students will then answer the following question on the graphic organizer sheet," What are the five steps needed in applying GIS to solve problems?" The second link leads to a short YouTube video illustrating the importance of GIS. After watching this video, students will answer the question: "What is the importance of GIS?"

Slide 4: What GIS Tells Us About Population Growth. After students have gained a basic understanding for GIS from their endeavors completing previous slides, this slide will actually engage them in work with a GIS map to help them understand what population growth means. Students will interact with two links to explore the population growth topic. The first link directs them to a GIS population growth map. With this map, students will discover the population growth rates for multiple countries spanning the years 1960 through 2010. The second link takes them to a Wikipedia page explaining the term 'population growth.' Students will then answer the following question on their graphic organizer sheet," What is a population growth rate?"

Slide 5: What GIS Tells Us About Population Growth in Kuwait. In this slide, students will interact with two links. The first link features a GIS world population growth map. Students will work with this map to learn the population growth rates for three different geographic levels: (1) Kuwait, (2) Arabian Gulf, and (3) Arabian countries. They will then click on the second link directing them to search www.google.com to find the world's population growth rate. Students can then make a comparison between populations in Kuwait, the Arabian Gulf region, Arabic countries as a whole, and the world at large to answer the associated questions on the graphic organizer sheet. This activity helps students to learn about population growth across multiple scales, broadening understanding for their nation by viewing it through a wider lens.

Slide 6: What GIS Tells Us About Human Development. This slide prompts students to use GIS to learn about the concept of human development. Students will interact with two links; the first directing them to a GIS map of the Human Development Index. In this map, students will discover the human development index rate across three different geographic levels: (1) Kuwait, (2) the Arabian Gulf, and (3) Arabian countries as a whole. The second link will direct them to www.google.com to allow students to search for information concerning the world's human development rate. Students can then make a comparison of these data between Kuwait, the Arabian Gulf region, the Arabic countries region, and the world as a whole to answer each of the associated questions on the graphic organizer sheet. This activity helps students to discover the Human Development Index over multiple scales.

Slide 7: Closure! This slide immerses students in open discussion. Students will first interact with a GIS map that features the following two layers: (1) population growth, and (2) human development. Students will investigate the relationships between these layers, write down their observations, and then begin a discussion with their group-mates. Teachers could ask their students to write and submit a brief summary of the conclusions they reached following their group's deliberations. This should help teachers monitor their understanding for the content.

The procedures for activity implementation*. To implement the staging of the Compelling Question task activity, in-class instructions should be followed. Teachers will follow the procedure below to enable their students to answer the introductory activity question:

1. Give students the story map graphic organizer sheet.
2. Have students open the website https://arcg.is/0GumvS. Inform them that this story map is intended as a presentation tool for introducing the staging of the compelling question content material. Teachers should use the provided story map graphic organizer as guidance for working with the story map itself.
3. The final story map slide, entitled ‘Closure!’ is a prompt for the interactive discussion activity. Students will openly debate, with their classmates and teacher, the relationships between population growth and human development.

Facilitating AIW through staging of the compelling question task. As noted in the introduction for this model, teachers should focus on six main AIW criteria through its implementation: (a) construction of knowledge; (b) deep knowledge (c) critical thinking skills; (d) elaborated communication; (e) conversation and discussion; and (f) value beyond school. The staging of the compelling question activity provides students with a foundation for three main topics: (a) GIS; (b) population growth; and (c) human development. It is essential for students to gain basic knowledge about the model to help them understand its key concepts before they move on to the Supporting Questions. Students construct their basic knowledge of the model by investigating GIS maps to explore population growth and development on different scales. For example, students will begin to gain understanding for the concept of GIS, how it works, and why it is important. They will also explore definitions for population growth and human development, and then discover how GIS can be employed to investigate these topics. They will compare population growth rates on different scales ranging from Kuwait alone, to the Arabian Gulf, to the Arabian nations as a group, and the world as a whole. They will learn that population growth has changed both spatially and temporally. Finally, they will use GIS to investigate the relationships between the Population Growth layer and the Human Development Index layer.

The Story Map Journal asks students to engage with various types of materials to understand the population growth topic; these materials include such things as pictures, maps, articles, and video to analyze information. To build their knowledge, students use higher order

* The procedures for the staging of the compelling question activity implementation were added.

thinking skills such as: comparing, exploring, analyzing, and interpreting information. Throughout each activity, save the last, students must work with a partner. They will work in a group during the last activity (closure) to share their knowledge with each other. This mingling of a student's thoughts and opinions with those of others leads to the creation of shared knowledge while also providing a more social learning environment. For example, the closure activity will open discussions about, "the relationship between population growth and human development," and this helps explore a wider range of thoughts with others. These opportunities help to create interpersonal communication, and provide a better chance of exploring multiple perspectives for the phenomena under examination. In addition, students explore a real-world, critical topic; one that affects their own country. They also connect their country with other parts of the world to compare how population groups differ from one place to other. Social studies teachers must consider all of these criteria when they decide to teach this model.

2. Supporting Questions, Formative Performance Tasks, and Featured Sources

This section contains three Supporting Questions with Formative Performance Tasks and Featured Sources to build student knowledge about the population growth topic. Students will learn the definitions for population growth, as well as the changes, causes, and consequences of this change. Each Supporting Question is described with a Formative Performance Task and sources. Please note that all required materials are attached and ready-to-use in Appendix F.

Supporting question #1, formative performance task, and featured sources. This Supporting Question engages students in working with GIS to discover the spatial and temporal changes of population growth in the world. The Formative Performance Task asks students to complete activities to answer Supporting Question #1. Teachers will use two GIS maps (Featured Sources) to enable students to answer this question. Table 13 provides a brief description about what is involved with Supporting Question #1.

Table 13

Supporting Question #1 Description

Supporting Question #1	How has world population changed over time?
Formative Performance Task	Use GIS tools (e.g. timeline bar, configure pop-up, and analysis) to identify how population has changed with time and location, and create a story map journal to demonstrate work and answer the Supporting Question.
Featured Sources	**Source 1:** World Population Growth GIS Map **Source 2:** Global Population Change in the 21st Century GIS Map
Time	Two 45-minutes class periods
Materials*	(A) Step-by-Step Instructions & Questions (B) Map Journal Instructions & Rubric (C) Peer Review Instructions (D) Peer Evaluation Form (E) Model of Supporting Question #1 Map Journal
Learning Objectives	Students will be able to use GIS tools such as configure pop-up, analysis, map journal, etc. to: - Explore world population changes both spatially and temporally. - Understand how population growth has changed temporally and spatially.
Social Studies Practices	Map Reading, Critical Thinking, Graphing, Using Evidence
GIS Skills	• Read map table and legend • Use configure pop-up tool to create a bar chart • Use GIS analysis tools (e.g. find location) • Create a Story Map Journal

Supporting question #1. This Supporting Question focuses upon providing students with an overview for how the world's population has shifted over time. To understand this question, students will use GIS to learn about the concept of population growth, and also global population growth trends. Students will acquire the essential GIS skills to explore how the population has changed from the past to the present day, and how it is predicted to change in the future. Some of these skills will include students being able to find and add data, read GIS maps, create bar charts, use analysis tools, and create a story map to help them understand the Supporting Question.

* Materials were added, and represented in Materials Box in Appendix F2.

Formative performance task for supporting question #1. This Formative Performance Task comprises a series of learning experiences that focus upon providing students with major content and essential GIS skills to enable them to answer Supporting Question #1 and, in so doing, moves them closer to being able to answer the model's Compelling Question. Students will complete five GIS-related activities in this Formative Performance Task. As Figure 8 illustrates, these activities are designed to follow the geographic inquiry steps (1) Ask, (2) Acquire, (3) Explore, (4) Analyze, and (5) Act. Table 14 delineates what Formative Performance Task #1 activities will involve.

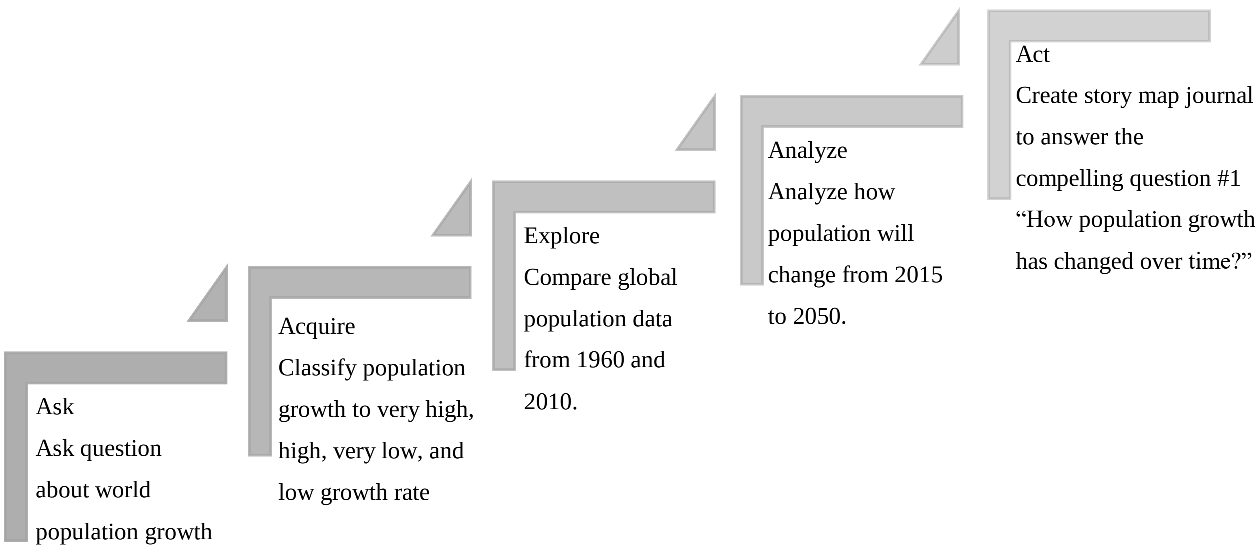

Figure 8. Formative performance task #1 activities.

Table 14

Formative Performance Task #1 Activities

Inquiry Steps	Question	Activity	GIS skills
Ask	What questions do you have about the World Population Growth Map?	Students will explore the GIS map "World Population Growth from 1960-2010"	*Find and add data *Read multi-layer map
Acquire	Classify the population growth data for 2010 as very high growth, high growth, low growth, and very low growth.	Students will read the map table and legend to show population growth details for each country.	*Show Map Table *Show Map Legend
Explore	Compare global population data from 1960 to 2010. How has the world's population changed?	Students will use the map's timeline to change years, and click on countries to show population growth details.	*Read map details *Use map timeline
Analyze	Analyze population data from 2015 and 2050. How is the population expected to change in the future?	Students will add a future population growth map, and convert population growth rates into a bar chart. They will also use analysis tools to identify countries predicted to have human populations in excess of one billion by 2050.	*Find and add data *Use configure pop-up tool to create bar chart * Use analysis tool
Act	How has world population growth changed?	Students will create a Story Map Journal to answer Supporting Question #1	*Create Story Map Journal

To engage students with these activities, teachers will distribute the step-by-step instructions and questions worksheet (see Appendix F2-Material A). This document provides clear directions, including illustrative pictures, that show how each activity should be performed. It also contains associated questions that students must answer after concluding each activity. Teachers will ask them to login to their ArcGIS Online accounts, then follow the worksheet instructions to execute the activities and answer questions. Students will employ ArcGIS Online maps to complete five activities (Ask, Acquire, Explore, Analyze, and Act) and construct their knowledge in pursuance of answering Supporting Question #1. Students will work with their partner to complete all activities except for the last one. The last activity (Act) asks students to work in a small group to create their own story map journal that demonstrates their understanding for Supporting Question #1. The following section describes these five activities:

Activity 1: Ask. The purpose of this activity is to ask students to work with their partner to explore the GIS "World Population Growth" map and formulate their own questions about it. In this activity, students will find, then add the GIS "World Population Growth" map. This document is a dynamic, GIS web map which allows students to discover the spatial and temporal patterns of population growth from 1960 through 2010. Students will examine this map in conversation with their partner, and write down relevant notes and questions about what they see. This activity enables students to gain background information about how the world's population is distributed, and how it has changed over time. Teachers should clarify for their students exactly why they want them to formulate their questions. As part of this effort, they could ask them, "What questions do you have? What are you interested in?" Then have them share these ideas with their partner to gain understanding for other perspectives and generate collaborative thinking. This will help teachers to motivate student curiosity about the world population topic.

Activity 2: Acquire. This activity is designed to inform students that each country has different experiences regarding population growth. Students will learn that there are high and low population growth rate countries in the world - and everything in-between. To bring about this understanding, each student will work with their partner to explore the GIS "World Population Growth" map in greater depth; clicking on countries to show details or read attribute tables. Students will read these map details, then fill out the relevant worksheet table. The table asks students to classify countries into one of four groups: (1) very high population growth, (2) high population growth, (3) low population growth and (4) very low population growth. After completing this activity, students will be able to read GIS details, such as the attribute table and legend, to gain more information about the countries under investigation. They will also learn that population growth has changed spatially.

Activity 3: Explore. The previous activity was designed to teach students that population growth varies spatially. This activity asks students to investigate how the population growth rate changes with time. To achieve this aim, students will observe population growth rates from 1960 to 2010 in the GIS "World Population Growth" map to discover the temporal and spatial patterns of population change, and the corresponding global trends. Students will display the map's attributes table (which provides a rich description about the population growth rate for each country from 1960 to 2010) and fill out the world population growth table in the worksheet. The table asks students to enter population growth data for eight counties from 1960 to 2010. Each student pair must fill out the table and answer the following four worksheet questions:

- Compare between world populations in 1960 and 2010. How has the world's population changed?
- Which countries experienced an increased population growth rate from 1960-2010?
- Which countries had a decreasing population growth rate from 1960-2010?
- Which countries experienced only minor or no population growth rate changes from 1960-2010?

This activity will enable students to track how population growth changes over time. They will also be able to make comparisons between countries, contrasting data for their own country (Kuwait) with those in others such as China, India, Germany, etc. This activity helps students to understand that population growth rate varies from one nation to another, and that it also changes over time. This activity also enables students to read GIS map details and use the map timeline.

***Activity 4: Analyze*[2].** This activity helps students to gain insight, analyze and make predictions concerning future world population growth. To accomplish this, students will add the GIS map 'Global Population Change in the 21st Century' to their ArcGIS Online account. This map visualizes future population by characterizing population densities with different colors. Deep red indicates high population growth countries on the map, while light red refers to those with low population growth. This map also allows students to read the attribute table, or click on a country to show actual population details from 2015 and the predicted results for 2050. In this activity, students will complete GIS exercises involving: (1) the bar chart, and (2) the analysis tool. In the first exercise, students will convert numerical data into a bar chart yielding a visual representation of these data. This bar chart will depict the population growth in 2015 and also in 2050, enabling students to compare between these two years easily. This exercise will enable students to understand how to use GIS to convert data from a numerical format into its visual representation, making it easier to interpret its deeper meaning. It will also help students to understand how population growth will change in the future.

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[2] This activity was revised, you can see the original activity in Appendix G.

In the second exercise, students will use analysis tool to identify which countries will likely have populations in excess of one billion by 2050. Students will accomplish this by accessing the ‘Find Location’ feature in the GIS ‘Perform Analysis’ tools list and then inputting specific criteria. Students will first select the “population number in 2050” layer in the ‘Global Population Change in the 21st Century’ map, then click the “more than” option, and finally enter “billion” in the blank box. After initiating the analysis, the result will be a new map that displays the countries predicted to have more than a billion people in 2050, highlighting them in a specific color. Completing this exercise enables students to improve their GIS skills, giving them the ability to employ the technology to perform analysis. As one can see, such GIS analysis tools allow students to investigate the spatial patterns and relationships in the data, and display the results as maps or charts. This also empowers students to answer inquiries via visual analysis.

Activity 5: Act[3]. After completing the previous activities, students will be ready to answer Supporting Question #1: "How has world population growth changed over time and space.” Students will collaborate in small groups for this activity. Each group will create a story map (Journal Type) about how world population has changed over time and space. They will support this document with evidence (numbers, examples, and maps) derived from their efforts in previous activities. This will help clarify a student’s ideas, and its completion should enable teachers to ensure that their students understand the Supporting Question. To achieve this activity, teachers must first give their students the “Map Journal Instructions and Rubric” sheet (see Appendix F2 - Material B). This sheet contains instructions and notes which students should consider. Students will use the rubric to learn what is expected of them while they work on their story map, especially the level of detail which they need to provide; this should help them to improve their efforts.

Peer Review Evaluation[*]. After students complete their map journal, the teacher will provide them with Peer Review Instructions and the Peer Evaluation Form (see Appendix F2-Material C&D). The Peer Review Instructions sheet provides step-by-step instructions for how students should share their story map journal with classmates. The Peer Evaluation Form contains a brief description covering the requirements for each group, complete with rubric explaining how to evaluate group work. Each group will read the instructions carefully. They

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[3] This activity was revised, you can see the original activity in Appendix G.
[*] Peer Review Evaluation activity was added.

will send their own work to another group, receiving their efforts in return. Students will use the Peer Evaluation Form to log their assessment of another group's labors, offering them feedback, comments, and suggestions to improve their work. Each group will receive feedback and employ any relevant comments contained within to improve their own work before submitting it for a grade.

***Procedures for implementation*[*].** To implement the Formative Performance Task #1 activities, teachers follow the instructions below to enable their students to answer Supporting Question #1:

1. Provide students with the step-by-step instructions sheet (see Appendix F2-Material A). Students will follow these instructions and, after completing each activity, answer the associated question on the same sheet.
2. Have students visit https://www.arcgis.com/index.html to log in to their ArcGIS Online account and begin working on the first four activities outlined on the instruction sheet. Students should work in pairs for this part of the assignment.
3. Inform students that they have 45 minutes to complete the first four activities and answer the associated questions.
4. After finishing the first four activities, provide students with the Story Map Journal instructions and rubric sheet (see Appendix F2- Materials B). Ask them to work collaboratively (in-groups), and to use results from previous activities to complete their Story Map Journal. Inform students that they have 25 minutes to complete this assignment, and remind them to read the instructions and rubric carefully to make sure that their Story Map Journal contains all of the required details.
5. Upon completing their Story Map Journal, students should be given a Peer Review Sheet (see Appendix F2-Material C), and Peer Evaluation Form (see Appendix F2-Material D) to guide them through the next activity. Students will share their Story Map Journal with their classmates to both give and receive feedback on their work. Each group will meet and take turns providing feedback on the work from other groups. They will also fill out the Peer Evaluation Form. After completing these feedback forms, each group will then revise their own Story Map Journal to reflect the relevant advice that they accepted from other groups. Students will then submit

[*] The procedures to the Supporting Question #1 implementation section was added.

their updated Story Map Journals to teacher for further evaluation. The entirety of this activity should take no more than 20 minutes. A model Story Map Journal is available in Appendix F2-Material E.

Facilitating AIW through formative performance task #1 activities. Through instruction of these activities, social studies teachers must work on facilitating inquiry and AIW criteria. The sequence of geographic inquiry activities will help students engage with inquiries to construct their knowledge about this subject, thus enabling them to answer the Supporting Question: *"How has population growth changed over time."*

Students must construct their knowledge by employing critical thinking skills. For example, teachers should ask students to compare, contrast, and analyze information on the map to understand how population growth has changed over time and space. There are five activities which students must complete to build their knowledge, and these follow the geographic inquiry steps: (a) Ask; (b) Acquire; (c) Explore; (d) Analyze; and (e) Act. In these activities, students work with GIS to understand how population growth has changed over time. For example, students compare the population growth between different countries and across different time periods. They divide these countries into sub-groups, categorized by population growth rate, as very high, high, low, and very low. They will also use GIS to create a bar chart to visually compare between present and future population growth. Students will also use the analysis tool to find locations that are predicted to have more than a billion people by 2050. These activities enhance student ability to think critically and to build their knowledge about the population growth topic.

Please note social studies teachers must also consider that their role as a teacher in these activities shifts from lecturer to facilitator; they will provide students with instructions, help them if needed, and monitor their progress. But as a facilitator, they should make sure their students also know to ask teacher for help if there is anything they don't understand. It is important to encourage their students to work collaboratively to help them build shared knowledge through the exchange of information with their peers. Social studies teachers must activate these discussions and conversation between students to provide them with the opportunity of discovering multiple perspectives. There are a variety of activities (e.g. story map journal, peer review, etc.) which can help facilitate communication, collaboration and discussion between students. For example, in the last activity (Act) students work in groups to create their own Story

Map Journal; through their work on this activity, students will share their thoughts, thinking, and ideas with other group members. Moreover, the peer review activity provides another opportunity for students to share and receive ideas and comments with classmates. This classroom interaction should provide students with useful feedback with which they can then amend their work to improve its quality, thus also teaching them about the revision process. These activities facilitate social interaction and collaborative work between students, which is important for their development.

And finally, meaningful intellectual accomplishments must also have value beyond school walls. Through teaching this task, teachers may prompt students to discover their country more fully and make connections with other parts of the world. They may also ask them to describe their own personal experiences and opinions regarding changes in population growth.

Featured sources of supporting Question #1. Students need to use Featured Sources to complete the Formative Performance Task activities that enable them to answer Supporting Question #1. Thus, teachers will ask students to work with the following two GIS maps to complete their GIS activities and answer the Supporting Question:

1. World Population Growth GIS Map (Carto, 2016). This is an ArcGIS Online map which allows students to discover the spatial and temporal patterns of population growth from 1960 through 2010 (see Figure 9).

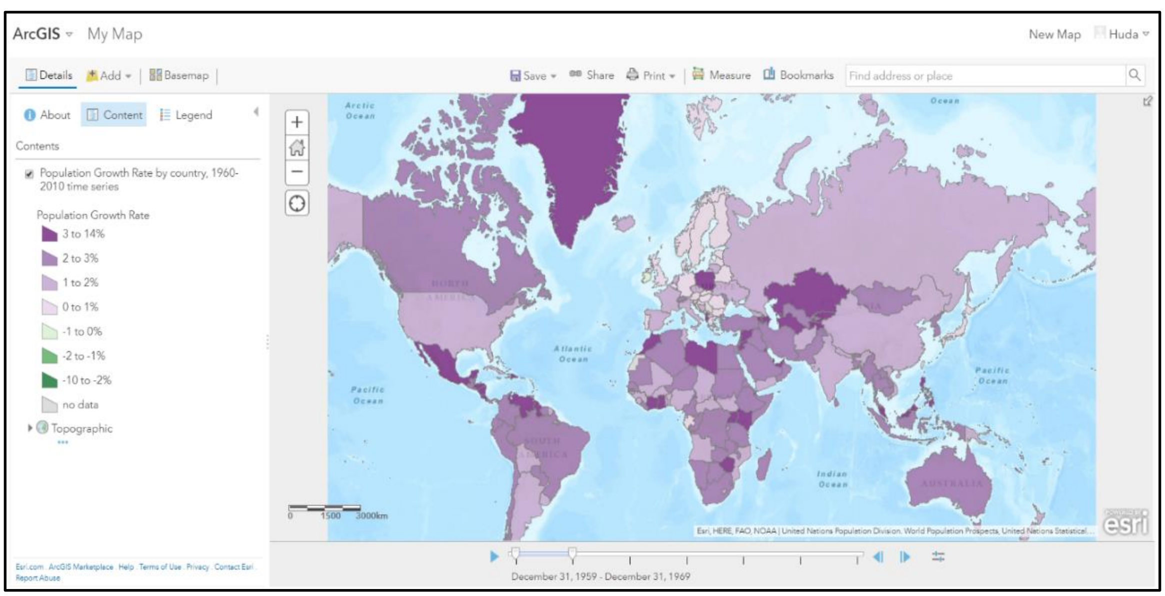

Figure 9. World population growth ArcGIS Online map hosted by ESRI.

2. Global Population Change in the 21st Century GIS Map (Walker, 2015). This is an ArcGIS Online map which provides global population data for three different years - 2012, 2015, and 2050 (predicted). This should enable the reader to compare the known population details from 2012 and/or 2015 with the predicted data for 2050 (see Figure 10).

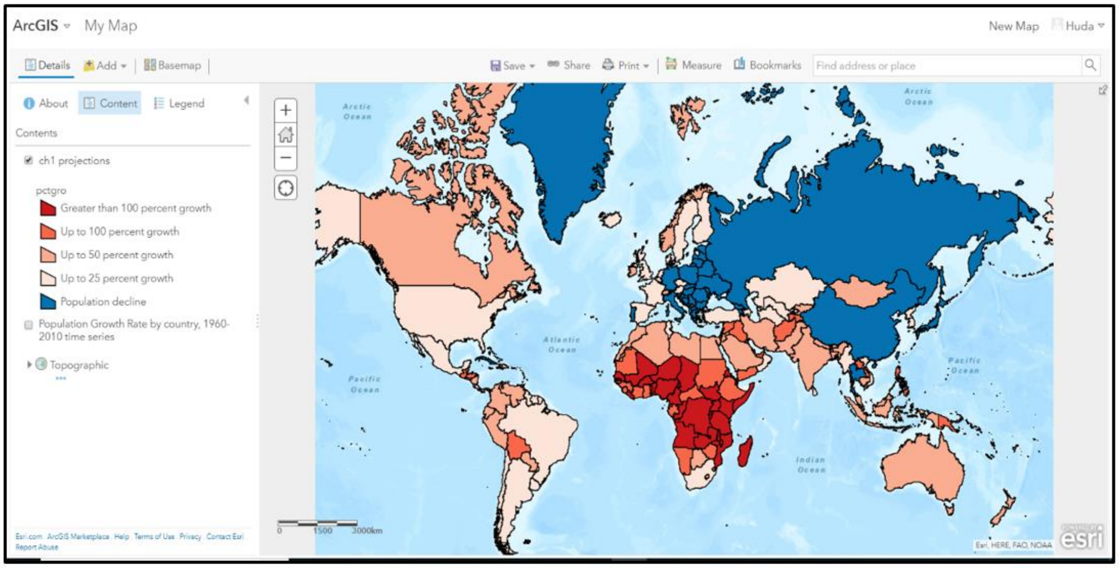

Figure 10. Global population change in the 21st century ArcGIS Online map hosted by ESRI.

Supporting question #2, formative performance task, and featured sources. This Supporting Question engages students to work with GIS to investigate the causes of population growth in the world. The Formative Performance Task asks students to complete several GIS activities to answer Supporting Question #2. Teachers will use two GIS maps to complete the activities in this task (Featured Sources). A brief description of Supporting Question #2 is presented in Table 15.

Table 15

Supporting Question #2 Description

Supporting Question 2	What are the causes of rapid population growth?
Formative Performance Task	Compare multiple layers in GIS maps using Symbology features, build your own GIS layer to demonstrate the causes of rapid population growth, and add slides to your map journal to show work and answer the Supporting Question.
Time	Two 45-minutes class periods
Featured Sources	**Source 1:** World Bank - Age and Population map **Source 2:** Infant Mortality Rate map **Source 3:** Websites below - https://www.latlong.net/ - https://data.worldbank.org/ - https://google.com
Materials[*]	(A) Step-by-Step Instructions & Questions (B) Map Journal Instructions & Rubric (C) Peer Review Instructions (D) Peer Evaluation Form (E) Model of Supporting Question #2 Map Journal
Learning Objectives	- Students will be able to use GIS tools to identify the causes of rapid population growth. - Students will be able to build GIS layers to compare between high, low, negative, and zero population growth rate countries.
Social Studies Practices	Critical thinking, graphing, map reading, using evidence
GIS Skills	- Symbology (**Heat Map** and **Counts and Amounts**) & Transparency - Configure pop-up (add images) - Build layer

Supporting question #2. This Supporting Question focuses upon providing students with information about the causes of global population growth. This inquiry is connected with the previous Supporting Question and those which follow. In Supporting Question #1, students gained a foundation of knowledge for how the world's population has changed. They should have concluded that it has increased rapidly overall, but differs from country to country. In this Supporting Question, students must work with GIS to explore the reasons behind these changes. They will use GIS to discover four primary factors: (a) natural rate of increase, (b) fertility rate, (c) infant mortality rate and (d) life expectancy. They must also consider the indirect contributors such as economics, education, and healthcare expenditure.

[*] Materials were added, and represented in Materials Box in Appendix F3.

Formative performance task for supporting Question #2. The Formative Performance Task for Supporting Question #2 calls for students to complete five GIS activities. Teachers will ask students to engage in classroom activities which comply with the five steps of geographic inquiry: (1) Ask, (2) Acquire, (3) Explore, (4) Analyze, and (5) Act. Figure 11 illustrates the Formative Performance Task activities to answer the Supporting Question #2. Table 16 illustrates how students will engage in Formative Performance Task #2 activities to answer the Supporting Question.

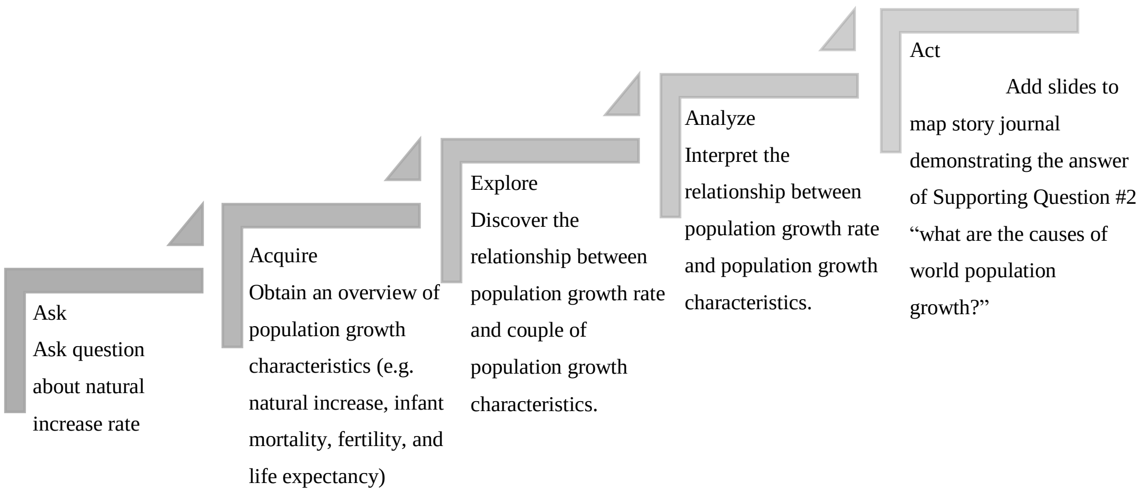

Figure 11. Formative performance task #2 activities.

Table 16

Formative Performance Task #2 Activities

Inquiry Steps	Question	Activity	GIS Skills
Ask	What questions do you have about the "Natural Increase" map?	Students will explore the "Natural Increase" GIS map.	*Find and Add data *Read a multi-layer map
Acquire	Which are the countries with high natural increase, fertility, life expectancy, and infant mortality rates? Which are the countries with low natural increase, fertility, life expectancy, and infant mortality rates?	Students will read the map table, timeline, and legend to show the natural increase, fertility, and life expectancy rate details for countries. They will also use the Symbology feature (Heat Map option) to visualize the infant mortality rate.	*Show map table *Show timeline *Show map legend *Symbology (heat map)
Explore	What is the relationship between population growth and natural increase, fertility, and life expectancy rates? Support your answer with examples. What are the causes of high fertility and low expectancy?	Students will use the Symbology (Counts and Amounts) and Transparency tools to compare the population growth layer with natural increase, fertility, and life expectancy rate layers. They will then select a country with a high fertility rate, and one with low life expectancy, after which they will Google the causes of high fertility and low life expectancy rates. Once they have identified these details, they will add the collected information to the map by using the Map Notes feature.	*Read map details *Use Symbology (Counts and Amounts) * Use map notes
Analyze	What are the identifying characteristics of high, low, and zero population growth rate countries? What did you learn about the zero population growth rate country?	Students will build their own GIS layer by: - Searching for the longitude and latitude of required countries. Search and collect information about population growth, literacy, health expenditure and poverty rates for these countries. Add all collected information to a CSV file. Insert the CSV file into GIS to create a layer. Use the Configure pop-up media tool to insert images for each country - After building their map, students answer questions.	*Find and add data *Build GIS layer *Use configure pop-up tool to insert image
Act	What are the causes of world population growth?	Students add new slides to their story map journal to answer Supporting Question #2	*Add slides to story map journal

To hook students into these activities, teachers will distribute the step-by-step instructions and questions worksheets (see Appendix F3-Material A). These documents provide clear directions with illustrations to show how each activity should be completed. There are also questions which students must answer after completing each activity. To begin this task, teachers will ask students to access their ArcGIS Online accounts and follow worksheet instructions to complete the activities and answer all questions. Students will work with a partner to complete all activities except the final one. For this last activity (Act), teachers will ask students to work in a small group to add slides to their Story Map Journal which demonstrate their understanding for Supporting Question #2. The following sections describe the five activities students must complete:

Activity 1: Ask. This activity introduces students to the 'natural increase' topic as a major reason behind population growth. To complete this task, each student pair will find, then add the "World Bank-Age and Population" GIS map to their journal. This document is a multi-layer GIS map that contains information about birth, death and fertility rates. Students will examine this map, reviewing its layers, and then respond to the following question: *"What questions do you have?"* This activity encourages student-generated questions to help them demonstrate their understanding for the topic being covered.

Activity 2: Acquire[4]. In this activity students will acquire understanding for basic population growth concepts, such as natural increase, fertility, and infant mortality rates. These basic concepts help students to identify the major causes of population growth in the world. To achieve this goal, students will complete two main exercises. In the first exercise, students will review population and age map data to learn and record the birth, death, fertility, and life expectancy rates across three different regional scales. Examining the "World Bank-Age and Population" GIS map, students will find the birth, death, fertility, and life expectancy rates for their country (Kuwait). They will then determine the corresponding rates for Arabian Gulf countries (second scale). And finally, they will discover the rates for Arabian countries as a whole (third scale). Students will then search www.google.com to determine the world's fertility and life expectancy rates, and compare them with data from their own nation to answer the following question: "*Are Kuwaiti life expectancy and fertility rates higher or lower than the*

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[4] This activity was revised, you can see the original activity in Appendix G.

world averages? If so, Why?" This activity will help students to better understand their own country, its region and other countries around them. It will also help them learn to use GIS to understand basic population characteristics over different scales.

The second exercise involves students employing GIS Symbology tools to convert infant mortality rate data from 2000 to 2015 into a heat map. A heat map provides visual representation of data to help bring better understanding for what it means. By converting infant mortality rate data into a heat map, students will quickly discover where the high and low infant mortality rates are located by simply observing the color tones on the document. Locations with low infant mortality rates appear on the map highlighted in cooler hues (blues), while those with high infant mortality rates are represented with much warmer tones (orange or red). Students will observe these data for their nation, their region (Arabian Gulf) and Arabian countries as a whole, comparing results to gain understanding for the phenomenon. Through their work on these exercises, students will make observations, and answer the questions on the worksheet.

Activity 3: Explore[5]. In the previous activity, students learned about birth, death, infant mortality, and fertility rates across the world. For this activity, teacher will ask students to explore the relationships between these concepts and population growth. This activity will involve students working on three exercises. For the first exercise, students will use the GIS Symbology feature to change the style of the birth rate layer on their map to the "Counts and Amounts" style. This format helps to convert numerical data into proportionally-sized polygons. Larger symbols imply larger numbers, while smaller symbols result from smaller numbers. To enable students to compare between these proportional points with the underlying layer, students should use the GIS Transparency tool to adjust the upper layer's opacity so that the underlying Layers show through. This will help them to make comparisons between the birth rate layer and the population growth layer. They should write down their observations on the worksheet. This exercise enables students to answer the following question: "*What are the relationships between population growth and birth rate? Support your answer with examples."*

In the second exercise, students will repeat steps from the previous exercise, substituting the fertility rate layer for birth rate. Students will change the fertility rate layer to represent the "Counts and Amounts" style and compare it with a similarly-styled population growth layer to

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[5] This activity was revised, you can see the original activity in Appendix G.

answer the worksheet question: "*What is the relationship between population growth and fertility rate?"* Students will then select a country with a high fertility rate, and search www.google.com to learn more about why this situation exists. Students will then add map notes to this country on their GIS map describing the reasons for the nation's high fertility rate.

Similarly, to the previous two exercises, the third exercise will involve students comparing the population growth and life expectancy layers to answer the worksheet question: *"What is the relationship between population growth and life expectancy rates?"* Then students will select a country with a low life expectancy rate and search www.google.com to learn why this is so. As before, students will then insert their findings on the GIS map using the map notes tool.

Activity 4: Analyze[6]. This activity encourages students to discover some of the indirect reasons for population growth, such as social and economic factors. In previous activities, students learned to find and add data to their GIS maps, to compare existing map layers, and to use the configure pop-up or Symbology features tools to visualize the data. For this activity, students will learn how to create their *own* GIS layer to analyze the social and economic reasons behind population growth. Students will learn how to convert collected data located on a spreadsheet file into a GIS map. Each student will work with their partner to create their own GIS layer by following the seven steps outlined below:

1. Students will create a new Microsoft Excel spreadsheet file for collecting their data. In Excel, they will create ten sheets: (1) country name, (2) longitude, (3) latitude, (4) population growth (5) the percentage of health expenditure, (7) literacy rate, (8) poverty rate (9) links, and (10) images.
2. Students will access the website www.latlong.net to fill out the longitude and latitude sheets on their Excel file with the corresponding data for seven countries: Niger, Oman, Poland, Georgia, Japan, France, and Germany.
3. Students will visit the website www.worldbank.com to find data for population growth, percentage of healthcare expenditure, poverty, and literacy rates for each country listed in step 2. They will enter these data in the appropriate sheet in their Excel file.

[6] This activity was revised. The activity, as originally created, is located in Appendix G

4. Students will copy the web-address for the World Bank website and paste it in the appropriate cell on their Excel file's Links sheet. This field will preserve the source attribution for the data collected in step 3.
5. Students will visit the website www.google.com to search for images that represent population growth in each country, and again insert the link for each image in the appropriate field on their Excel file.
6. Students will save their Excel file in a Comma-Separated Values (CSV) format, and convert this file into a GIS layer.
7. Students will access ArcGIS Online to show their layer, and use the configure pop-up tool to insert images describing the population growth in each country.

After they create their own GIS layer, each pair of students will show this layer, separating the seven countries into groups by population growth rate: high, low, zero, and negative. They will also investigate the relationships between population growth and healthcare expenditure, poverty, and literacy rates for high, low, zero, and negative population growth countries. Students will perform an internet search using www.google.com to learn more about the negative and zero population growth rate countries. Students should learn that there are relationships between a location's population growth rate and its economic and educational status.

Activity 5: Act[7]. After completing the previous activities, students should be able to answer Supporting Question #2: "What are the causes of world population growth?" Before students begin their work, teacher will first give them the document entitled "Map Journal Instructions and Rubric" (see Appendix F3-Material B) which helps explain the activity's requirements and the necessary procedures for completing it. This activity requires students to work within a small group as they demonstrate their understanding for the Supporting Question. Using evidence gathered in previous work, each group will add slides to their story map journal to illustrate the causes of rapid population growth around the globe. Adding slides to this story map journal will help students to connect their new knowledge with what they have already learned. Students will use images, graphs and GIS maps to support the conclusions that they draw with their story map journal in answering Supporting Question #2.

[7] This activity was revised; you can see the original activity in Appendix G.

Peer Review Evaluation[*]. After students complete this activity, teacher will provide them with the "Peer Review Activity Instructions" and "Peer Evaluation Form" (see Appendix F3-Materials C&D). Students should read these instructions carefully. Each group will send their work for evaluation to another group. They will exchange feedback with each other and use any relevant information from this process to improve their own work before submitting it for grading.

***Procedures for implementation*[*].** To implement Formative Performance Task #2 activities in-class instructions should be followed. To enable students to answer Supporting Question #2, teachers will apply the following instructions:

1. Provide students with the step-by-step instructions (see Appendix F3-Material A). Students will follow these instructions, answering questions on the same sheet after completing each activity.
2. Have students visit the website https://www.arcgis.com/index.html to log in to their ArcGIS Online accounts and start working on the first four activities.
3. Remind students that they have to complete these first four activities with their partner, and that they will have 60 minutes to do so, which includes answering all questions. They must also let teacher know when they have finished this work.
4. Give students the story map journal instructions and rubric sheet (see Appendix F3-Material B). Ask them to work collaboratively (in their group) on this activity, and to use their previous work to complete their story map. Remind students to read the instructions and rubric carefully to make sure that their map journal contains everything required. Tell students that they have 15 minutes to complete their story map journal. Give students the Peer Review Activity sheet (see Appendix F3-Material C), and Peer Evaluation form (see Appendix F3-Material D) to guide them through this activity. Students will share their map journal with their classmates, so that everyone can both give and receive feedback on their work. Each group will meet and take turns in providing feedback to the other groups. Students will also fill out the Peer Evaluation Form. Upon completing these forms, each group has the opportunity to revise their story map journal to reflect relevant advice that they have received

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[*] Peer Review Evaluation activity was added.
[*] The procedures for implementing Supporting Question #2 were added.

from other groups. They will then send to teacher their updated story map journal so teacher can evaluate their work. Tell the class that this activity will take no more 15 minutes. Teacher can find a model story map in Appendix F3-Material E.

Facilitating AIW through formative performance task #2 activities. Through instruction of these activities, as a social studies teacher, social studies teachers must facilitate inquiry and the following AIW criteria (a) construction of knowledge, (b) deep knowledge, (c) critical thinking skills, (d) elaborated communication, (e) discussion and collaboration, and (f) value-beyond school. The sequence of geographic inquiry activities (e.g. Ask, Acquire, Explore, Analyze, and Act) will help students to construct their knowledge about the causes of population growth. Through these activities students will use higher order thinking to construct their deep knowledge. For example, in the first activity, students read a multi-layer GIS map to formulate their questions about the causes of population growth. In the second activity, students gain information about the major causes of population growth: natural increase, infant mortality, and fertility rates. In this activity, students will investigate the rates of birth, infant mortality, and fertility across different scales. They will also make a comparison of these rates between their country and the world as a whole. In the third activity, students will use the GIS Symbology feature to visualize the data and determine the relationships between birth, infant mortality, and fertility rates in comparison to population growth. In the fourth activity, students create their own GIS layer to investigate the relationships between social and economic factors in comparison to population growth for countries with high, low, zero, and negative population growth rates. In the last activity, students demonstrate their understanding for the causes of population growth by adding slides with relevant evidence to their story map journal.

Previous activities asked students to compare, contrast, interpret, make relationships and synthesize the data to investigate the causes of population growth. However, the GIS activities involved with this Supporting Question are more advanced than those engaged with previously. Students will build their own GIS layer rather than analyzing an existing example. Students will search, collect and insert visually representative data to understand the spatial variations between countries regarding population fertility, infant mortality, and life expectancy rates. Higher order thinking helps students deepen their understanding of the content.

It is important to encourage students to work collaboratively through these activities to help them build shared knowledge. Building shared knowledge will help students to discover multiple perspectives for the phenomena that they are observing and also improve their understanding for them. Social studies teacher must activate discussion and conversation between students to provide them with the opportunity to discover multiple viewpoints and opinions. There are several activities (e.g. working in pairs, story map journal, peer review, etc.) that facilitate communication, collaboration and discussion.

And finally, meaningful activities must have value-beyond school and be related to student personal experience. Through teaching this task, students will compare multiple population growth concepts (e.g. fertility, and life expectancy rates) between their country (Kuwait), and countries around them (region), and the world as a whole. Teachers may ask students to provide their opinions about these comparisons and to share these thoughts with their peers.

Featured sources for supporting question #2. Students need to use Featured Sources to complete the Formative Performance Task activities that enable them to answer Supporting Question #2. Thus, teachers will ask students to work with two GIS maps, and various websites to complete the GIS activities and answer the Supporting Question:

1. The World Bank - Age and Population GIS Map (International User Community, 2018). This is a multi-layered ArcGIS online map that provides rich data about global birth, death, life expectancy and fertility rates between 1960 and 2012 (see Figure 12).

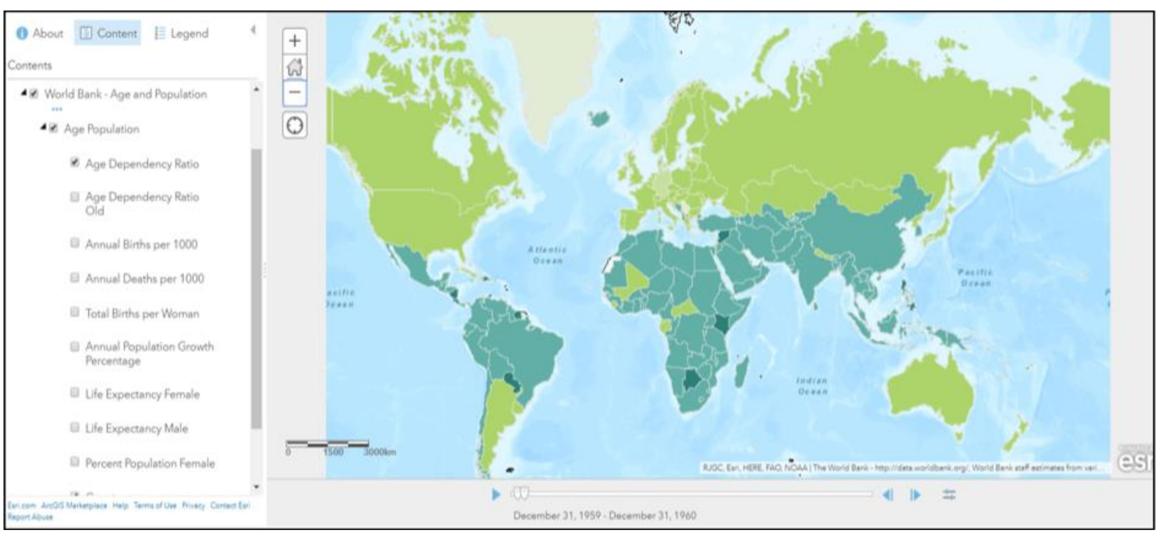

Figure 12. The World Bank - Age and population ArcGIS Online map hosted by ESRI.

2. Infant Mortality Rate (Unstats, 2017). This ArcGIS Online map shows global infant mortality rates (deaths per 1,000 live births) from 2000 to 2016 (see Figure 13)

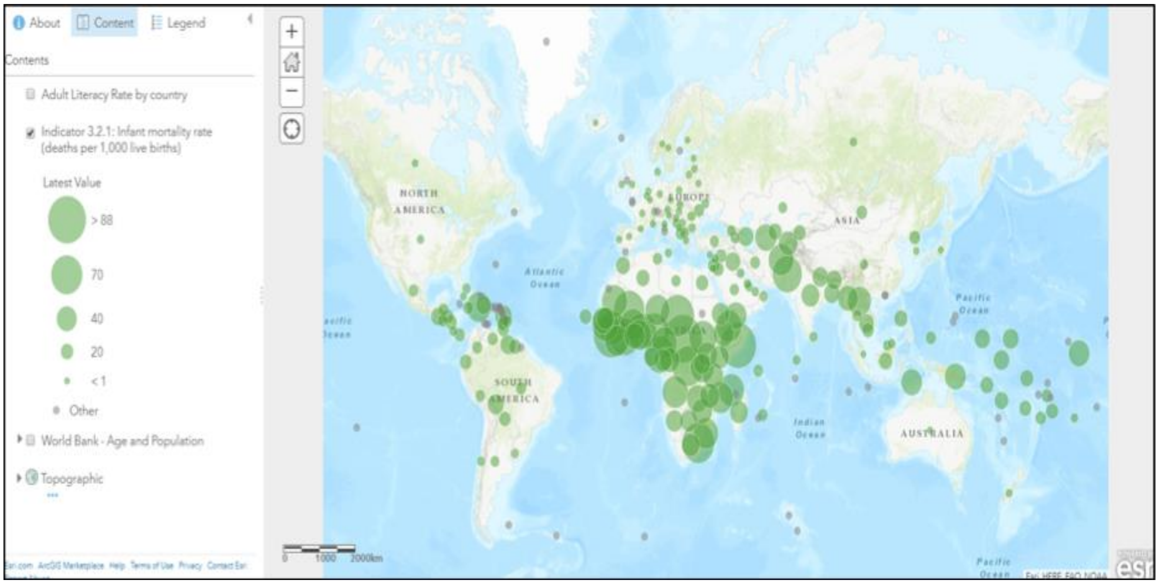

Figure 13. Infant mortality ArcGIS Online map hosted by ESRI.

3. **Websites.** Students will use the following websites to obtain the required data for creating their own GIS layer:
   - https://www.latlong.net/
   - https://data.worldbank.org/
   - https://google.com

Supporting question #3, formative performance task, and featured sources. This Supporting Question asks students to work with GIS to identify the consequences of population growth in the world. The Formative Performance Task engages students to work with GIS to complete five activities to answer Supporting Question #3. Teachers will use two GIS maps to complete this task. Table 17 presents a brief description of Supporting Question #3.

Table 17

Supporting Question #3 Description

Formative Performance Task	Add GIS maps on a 3D imagery scene, and create your own GIS map by adding points, creating an attribute table, using Symbology features to understand the consequences of population growth. Add slides to your story map journal to show your work and understanding for the Supporting Question.
Time	Two 45-minutes class periods
Featured Sources	Source 1: Tree Cover Loss map Source 2: World Population Density map Source 3: https://data.worldbank.org/
Materials*	(A) Step-by-Step Instructions & Questions (B) Map Journal Instructions & Rubric (C) Peer Review Instructions (D) Peer Evaluation Form (E) Model of Supporting Question #3 story map journal
Learning Objectives	- Students will learn about the consequences of rapid global population growth. - Students will spatially explore the relationships between population growth and societal problems.
Social Studies Practices	Map reading, critical thinking skills, geographical reasoning, using evidence.
GIS Skills	- 3D imagery scene - Build GIS layer - Add points - Create an Attribute Table - Symbology

Supporting question #3. The previous Supporting Question gave students the knowledge about the causes behind global population growth. This question will provide understanding for the *consequences* of such growth. Students will learn four damaging results: (a) deforestation, (b) environmental problems, (c) economic factors, and (d) social factors. They will use ArcGIS Online tools to explore the effects of overpopulation, and how population growth will affect people's lives and their environment.

* Materials were added, and represented in Materials Box in Appendix F4.

Formative performance task for supporting question #3. The Formative Performance Task for Supporting Question #3 requires students to use a 3D GIS map and build a GIS layer to identify the causes of population growth. They will then continue their Story Map Journal describing the consequences of global population growth. The activities were designed to follow the geographic inquiry steps (1) Ask, (2) Acquire, (3) Explore, (4) Analyze, and (5) Act as showed in figure 14. Table 18 illustrates how students will engage in Formative Performance Task #3 activities to answer the Supporting Question.

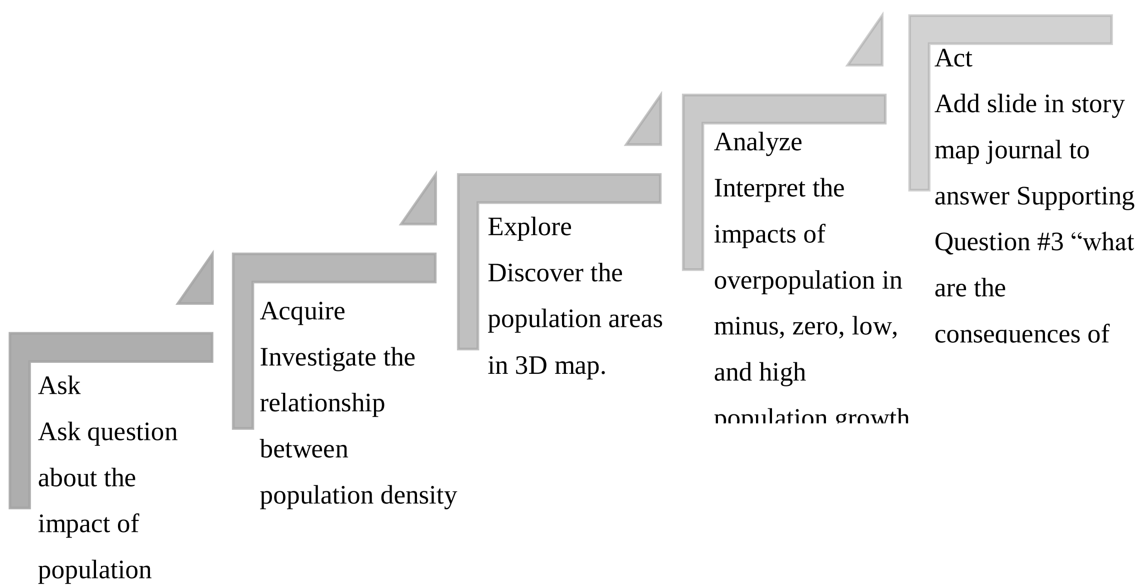

Figure 14. Formative performance task #3 activities.

Table 18

Formative Performance Task #3 Activities

Geographic Inquiry Steps	Question	Activity	GIS skills
Ask	What do you already know about the consequences of rapid population growth? What do you want to know?	Each pair will create their own questions about what they know and want to know about the consequences of population growth.	-
Acquire	Is there any relationship between population density and tree cover loss? Why?	Students will add the GIS tree cover map and density map, and examine the relationships between them.	*Find and add data.
Explore	How may population affect the environment?	Students will add a world density map to the 3D imagery scene to investigate the environment in population zones.	*Add data *3D imagery scene
Analyze	Is there a relationship between population growth and poverty? If so, describe it? Is there a relationship between population growth and economic growth? If so, describe it?	Students will create their own GIS map by adding points, creating an attribute table, and using Symbology features to visualize the relationship between population growth, economic growth and poverty for low, high, minus, zero population growth countries.	*Build a GIS layer *Add points *Create an attribute table *Symbology
Act	How world population growth has changed?	Students will add slides to their story map journal to answer Supporting Question 3	*Adding slides to a story map journal

To hook students into these activities, teacher will distribute the step-by-step instructions and questions worksheets (see Appendix F4-Material A). These documents provide clear directions with illustrations to show how each activity should be completed. There are also questions which students must answer after completing each activity. To begin this task, teacher will ask students to access their ArcGIS Online accounts and follow worksheet instructions to complete the activities and answer all questions. Students will engage with ArcGIS Online maps to complete five main activities to construct their knowledge regarding Supporting Question #3. Students will work with a partner to complete all activities except the final one. For this last activity (Act), teacher will ask students to work in a small group to add slides to their Story Map

Journal which demonstrates their understanding for Supporting Question #3. The following sections describe the five activities students must complete:

Activity 1: Ask. In the first activity, students must answer the following question: "*What do you already know about the consequences of population growth, and what do you want to know"?* Students will work with their partners, sharing their prior knowledge and personal experiences about the subject. This will help prompt them to think about what they want to know, stimulating their curiosity, and hopefully encouraging them to become active learners.

Activity 2: Acquire. This activity asks students to investigate the relationships between population growth and tree cover loss. Students will explore the environmental issues in highly populated areas. To complete this task, each pair of students will add a "tree cover loss" layer to their GIS map. They will inspect the spatial distribution of global deforestation, and record their observations. Students will then add a "world population density layer" onto the "tree cover loss" layer in order to spatially analyze the relationships between areas of population and deforestation; again recording notes about their findings. Each pair of students will then answer the following question: *"Are there any relationships between population density and tree cover loss? If so, what are they?"*

Activity 3: Explore. This activity requires students to discover the characteristics of highly populated countries, and to learn why such countries also have high tree cover loss. Students will use the GIS 3D scene to identify areas of high population and understand what they look like. Students will add a world density map onto the 3D scene to discover what the high density areas look like. Students will observe that the highly populated areas have streets, buildings, hospitals, lights, etc. and relate how these may affect the environment. These details may indicate that countries will remove trees to build infrastructure for their people, leading to increased overall tree cover loss. Completing this activity enables students to answer the following question: *"How may population affect the environment?"* Students will investigate the connections between urbanization and global tree cover loss to answer this question.

Activity 4: Analyze[8]. This activity will help students to identify the economic and social consequences of population growth. To achieve this goal, students will create their own GIS map to help them demonstrate the economic and social consequences of population growth. In the

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[8] This activity was revised, you can see the original activity in Appendix G.

fourth activity for Supporting Question #2, students converted their Excel spreadsheet file into a GIS layer. However, in this activity, students will create their own GIS layer by using the GIS editable features. To accomplish this, students will first use the point feature in the GIS editable tools to select the locations for eight countries. These eight countries will include two with high population growth rates, two with low population growth, two with zero population growth, and two with negative population growth. Students will then create a GIS attribute table to add data for each country. They will visit the Word Bank’s website, then note and log the following information for each country: (1) economic growth rate, (2) poverty rate, (3) unemployment rate, and (4) human development rate. Finally, they will use the GIS Symbology feature to represent countries with different colors that depend upon their population growth rates. Red will represent high population growth; low population will be green; zero, dark gray; and negative, light gray. Students will then show the details for each country and investigate the relationships between population growth in comparison to poverty, unemployment and human development rate. Students will annotate their findings on the worksheet. Students may find that highly populated countries have commensurately high poverty and unemployment rates, and these will result in a low human development index. Students will perform analysis to learn how population growth may lead to social and economic problems.

Activity 5: Act. In previous activities, students gained knowledge about the consequences of population growth. This activity asks students to clearly organize and demonstrate this information. To achieve this aim, teacher will provide students with the document entitled: "Map Journal Instructions and Rubric” (see Appendix F4-Material B). Students will work in small groups to add slides to their story map journals to help answer the following question: “What are the consequences of population growth?” In their story map journal, students will use GIS maps with supportive text describing the consequences of global population growth. Adding slides to their story map journal will help students to connect new information to their prior knowledge, helping to build understanding for the population growth topic.

Peer Review Evaluation[*]. After students complete this activity, teacher will provide them with the "Peer Review Activity Instructions” and “Peer Evaluation Form.” Students should read these instructions carefully. Each group will send their work for evaluation to another group.

[*] Peer Review Evaluation activity was added.

They will exchange feedback with each other and use any relevant information from this process to improve their own work before submitting it for grading.

***Procedures for implementation*[*].** To implement Formative Performance Task #3 activities, in-class instructions should be followed. To enable students to answer Supporting Question #3, teachers apply the following instructions:

1. Give students the step-by-step instructions sheet (see Appendix F4-Material A). Students will follow these instructions, answering questions on the same sheet after completing each activity.
2. Have students visit the website https://www.arcgis.com/index.html to log in to their ArcGIS Online accounts and start working on the first four activities.
3. Remind students that they have to complete the first four activities with their partner, and that they have 60 minutes to do so, which includes answering all questions. They should also tell teacher when they have finished their work.
4. Give students the story map journal instructions and rubric sheet (see Appendix F4-Material B). Ask them to work collaboratively (in their group) on this activity, and to use their previous work to complete their story map. Remind students to read the instructions and rubric carefully to make sure that their map journal contains everything required. Tell students that they have 15 minutes to complete their story map journal.
5. Give students the Peer Review activity sheet (see Appendix F4-Material C), and Peer Evaluation form (see Appendix F4-Material D) to guide them through this activity. In this activity, students will share their story map journal with their classmates, so that they can both give and receive feedback on their work. Each group will meet and take turns in providing feedback to the others. Students will also fill out the Peer Evaluation form. Upon completing these forms, each group will revise their story map journal to reflect the relevant advice that they have received from other groups. They will then send to teacher their updated story map journal so she/he can evaluate their work. Inform the class that this activity will take no more than 15 minutes. Teacher can find a model story map journal in Appendix F4-Material E.

[*] The procedures to the Supporting Question #3 implementation section was added.

Facilitating AIW through formative performance task #3 activities. Through instructing these activities, social studies teachers must work on facilitating AIW criteria through inquiry. The sequence of geographic inquiry activities will help students to construct their knowledge about the consequences of population growth. It is important to encourage students to work collaboratively through these activities to help them build shared knowledge. Building shared knowledge will help students to discover multiple perspectives for the phenomena that they are observing and also deepen their understanding for them. Teachers must activate discussion and conversation between students to provide them with the opportunity to discover multiple viewpoints and opinions. There are several activities (e.g. working in pairs, story map journal, peer review, etc.) that facilitate communication/ collaboration.

Moreover, students must construct their knowledge by using critical thinking skills. The GIS activities involved with this Supporting Question are more advanced than those engaged with previously. Students will use 3D imagery and attach this layer with a density map to explore the characteristics of high and low population areas. Students will also build their own layer by adding points and creating an attribute table to visually represent the data by using symbology features. Using critical thinking skills, via working with GIS, will help students to understand the consequences of population growth from a spatial perspective.

And finally, meaningful activities must have value-beyond school and relate to student personal experiences. Through teaching this task, students will gain understanding for the consequences of population growth in the world. Teacher may ask students to provide their opinions about these consequences (as they are part of the world,) and to share these thoughts with their peers.

Featured sources of supporting question #3. Students need to use Featured Sources to complete the Formative Performance Task activities that enable them to answer Supporting Question #3. Thus, teachers will ask students to work with two GIS maps to complete GIS activities and answer the Supporting Question:

1. Tree Cover Loss GIS Map (Global Forest Watch, 2015). This ArcGIS Online map provides information about global tree cover loss (see Figure 15)

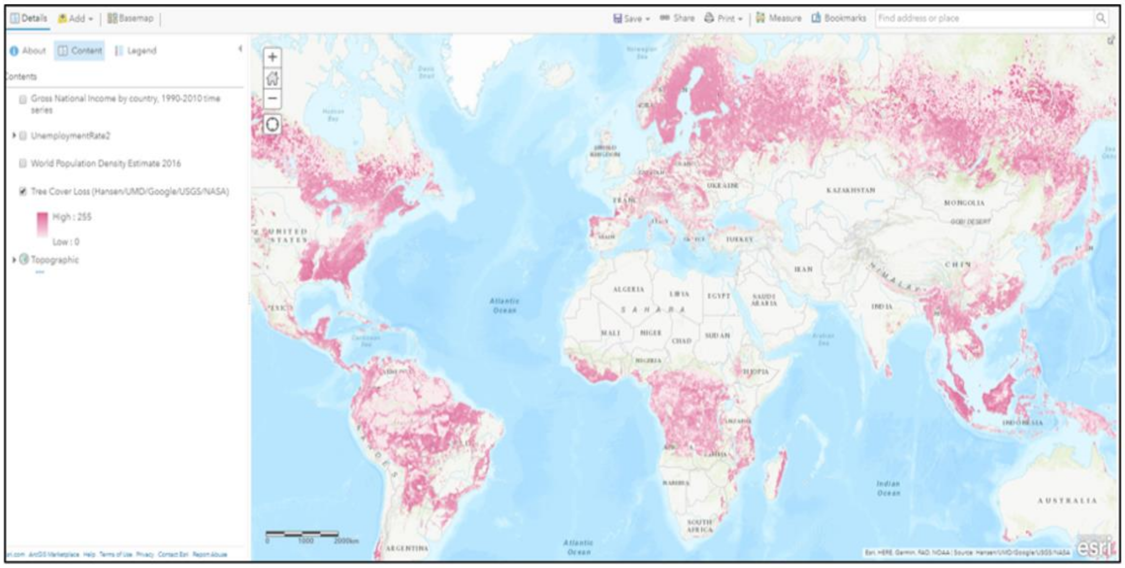

Figure 15. Tree cover loss ArcGIS Online map hosted by ESRI.

2. World Population Density GIS Map (ESRI, 2017). This ArcGIS Online map provides an estimate of population density in persons-per-square-kilometer for people living within the area represented by the cell (see Figure 16).

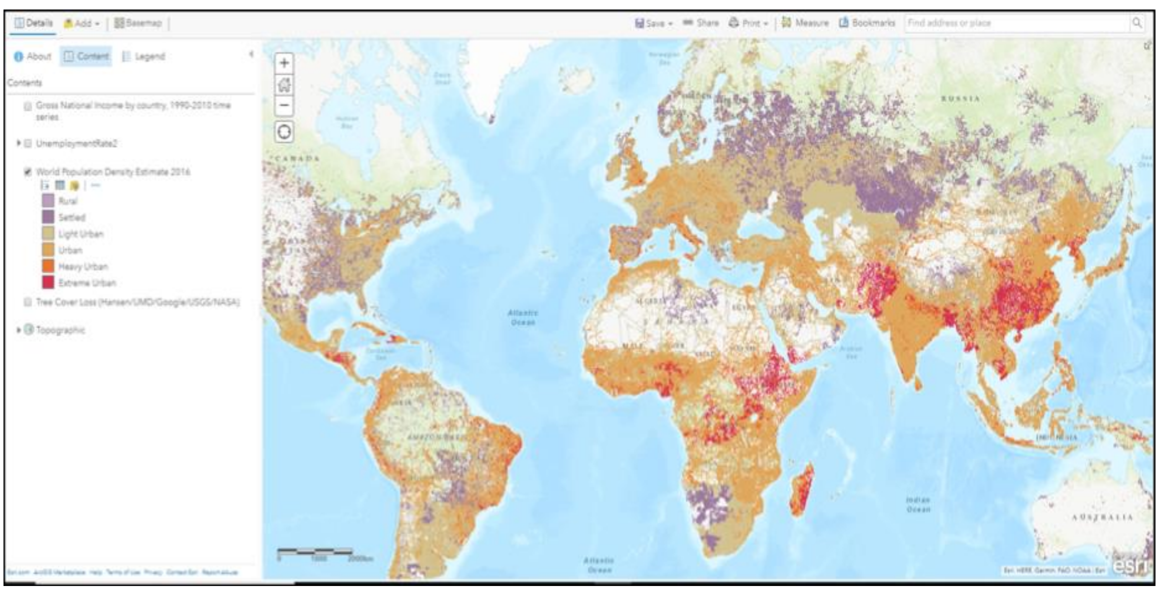

Figure 16. World population density ArcGIS Online map hosted by ESRI.

3. Website. Students will access the World Bank website (https://data.worldbank.org/) to collect required data.

3. Summative Performance Task

In this task, students will apply their prior knowledge and skills to build their arguments. The previous Supporting Questions should have prepared students to complete this task. Students will work within a small group and engage in open discussion to address both points of view about the population growth topic. Completing this task should enable students to answer the GIS Instructional Model's compelling question. Table 19 provides a brief description of this Summative Performance Task's activities.

Table 19

Summative Performance Task Description

Summative Performance Task	**Argument**: Is population growth good or bad for human development? The argument activity will be a discussion-based activity (work in groups) to construct an argument that addresses both the positive and negative sides of population growth using specific claims and relevant evidence from GIS maps while acknowledging the competing views.
Time	Two 45- minutes class periods
Learning Objectives	Students will use the story map app to: Address the good and bad sides of population growth on human development.
Materials*	(A) Argumentative Essay Instructions (B) Argumentative Essay Evaluation Form (C) Model of Argumentative Essay
Social Studies Practices	Comparison and contextualization, critical thinking skills, geographical reasoning, using and interpreting evidence
GIS Skills	Story map

This will be a discussion-based activity in which each group will debate amongst themselves to construct an argument. Students will use the story map app, and are free to choose the format for their story (e.g., journal, tour, series, etc.). In their debate, each group will discuss both sides of a position, using specific claims and relevant evidence from their previously created, multi-layer GIS maps. This inquiry requires students to demonstrate their understanding and ability to use and interpret evidence to support their claims. As students work in the Summative Performance Task, they will demonstrate their social studies skills such as gathering, organizing, interpreting and using evidence.

* Materials were added, and represented in Materials Box in Appendix F5.

In the Summative Performance Task, students should endeavor to understand multiple perspectives to an argument. They should also review their work from previous Formative Performance Tasks. This will help them gather information and appropriate evidence to support their claims. In this activity, teacher should engage students to work collaboratively, and remind them to consider all points of view to develop their positions and story map.

To begin this activity, first teacher will distribute instructions for creating an argumentative essay to class (see Appendix F5-Material A). The argumentative essay instruction sheet explains the purpose and process for creating the argumentative essay. It also clarifies the evaluation process, providing the rubric which teacher will use to assess their essay. Students must read these directions carefully before beginning work to create their group's story map.

To form their argumentative essay, students should follow four main steps. They must begin by first choosing the type of story map they want to use. Then, as a group, they should brainstorm their ideas concerning the benefits and/or drawbacks of world population growth (using notes from previous lessons). Third, they should collect and collate the evidence to support their viewpoints (GIS maps, graphs, and images). And finally, they will write down their argument. To ensure the quality of their essay, they should follow the rubric and instructions in the sheet.

The argumentative essay should contain six main parts: (1) introduction, (2) claim, (3) evidence, (4) counterclaim, (5) rebuttal, and (6) conclusion. Students should write a brief description of their essay with the introduction. For the claim, students should write their answer to the question:“ Is population growth good or bad for human development?” They should also provide a brief reason for their answer in this statement. They should then back up their answer with at least three pieces of evidence from their previous activities. They may use maps, images, chart, and examples to support their opinion. For the counterclaim, students should consider the likely opposing points of view to their own, and clarify the other side's positions. With their rebuttal, students will provide evidence that weakens their opponent's perspective. Students will conclude their essay with a brief summary of their argument.

After formulating their ideas into a coherent narrative, each group will present their argument to the class in a story map format. Following their presentation, each group will receive verbal comments and suggestions from their classroom peers. Remind students to write these details down, so that they can revise their story map journal to include any improvements based upon this in-class critique. Once each group has updated their work, they must submit it to teacher for formal review. Teacher will use the argumentative essay evaluation form (see Appendix F5-Material B) to appraise each group's efforts.

***Procedure for implementation*[*].** To enable students to complete the Summative Performance Task, teachers will follow the instructions below:

1. Before starting their essay, teachers will give students the explanation of the essay requirements and the rubric's scoring and ask them to focus on the rubric topics (see Appendix F5-Material A).
2. Teachers should inform students that this 45-minute activity to create their essay will be collaborative and based upon group discussion.
3. Students should debate each idea with their group members to clarify points and build evidence supporting their position.
4. Each group will present their argument and receive five minutes' feedback from their peers. They will be allowed an opportunity to revise their essay based upon the feedback they receive from fellow classmates before re-submitting it for final grading. The teacher will use the argumentative essay evaluation form (Appendix F5-Material B) to assess student work. A model argumentative essay is in Appendix F5-Material C.

Facilitating AIW through the summative performance task. The Summative Performance Task was also designed to facilitate AIW criteria through inquiry. After completing the three questions, students will be able to write an argumentative essay to answer the compelling question. Students employ GIS maps, graphics, and worksheets to form their judgment. They also use prior knowledge, and its thoughtful application, to answer the Compelling Question. Students will engage in a debate about how population growth has changed over time. They must also employ their critical thinking skills to examine both perspectives to the argument by analyzing population growth around the world, and interpreting its causes/effects to answer the Compelling Question.

Moreover, in this task, students will work in groups to discuss their opinions, experiences and GIS efforts to build their argument. Sharing opinions and ideas will help students to improve

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[*] The procedures for the Summative Performance Task implementation was added.

their understanding; self-correction or peer-correction may occur. At the end of this task, each group makes a presentation to deliver their argument and receive feedback. This will lead to increased communication (e.g. written, visual, verbal, and audio) between students. Finally, the argument opens the window for the exploration of different opinions and perspectives. Students will share their own experiences and make connections with real-world situations to develop their argument.

4. Taking Informed Action

Students will work in groups to complete their project regarding "population growth in Kuwait." Each group will use ArcGIS Online to complete all required activities. Table 20 provides a brief description of the Taking Informed Action tasks.

Table 20

Taking Informed Action Task Description

Taking informed action will involve a Project-based GIS	
Time	Two 45-minutes class period
Taking Informed Action Steps:	**Understand:** Create a GIS map that shows how population has changed in Kuwait, and the effects, and causes of population growth. **Assess**: Create an action plan to address the consequences of population growth in Kuwait. **Action:** Write an e-mail to a policymaker proposing changes to the highly populated governorates to accommodate future growth.
Materials*	(A) Overview of GIS Project (B) Project based GIS: Step by Step Instructions (C) Presentation Instructions (D) Self and Peer Evaluation of GIS Group Project Form

In this inquiry, students will work with ArcGIS Online to engage in three activities which require them to; (1) understand the population growth topic in local context (Kuwait); (2) assess the impact of population growth in Kuwait; and (3) act in ways that allow students to suggest changes to manage population growth in Kuwait. Students should draw their conceptual understanding for "population growth" by considering how it has changed in their country (Kuwait). In this way, students will transfer their knowledge about global population growth into

* Materials were added, and represented in Materials Box in Appendix F6.

another context. They will be able to evaluate how population growth affects people's lives in Kuwait. They could also evaluate how the effects of population growth in Kuwait can be similar and/or different from other countries.

For this inquiry, students will engage in project-based GIS to understand both how population growth has changed in Kuwait, and the effects of this change. Students will work with GIS to create their own maps that show the temporal and spatial analysis of population growth in Kuwait. Teacher will distribute the project-based GIS worksheet, guidelines and rubric to clarify how students might complete this task in an effective way (see Appendix F6). This task asks students to complete three main assignments to create their own project: (1) Understand, (2) Assess, and (3) Act. Table 21 explains the activities within a GIS-based project.

Table 21

GIS-Based Project Activities

Project Phases	Activity	GIS Skills
Understand	In this phase, students complete these 5 activities: 1. **Create their own map:** Students draw a GIS map of Kuwait's provinces using the polygon feature. They will then create an attribute table to write down the names of each province, and will use the label feature to display these names on the map. 2. **Demographics:** Students will add five fields on the attribute tables for population (1975, 1985, 1995, 2005, and 2015). They will then access Public Authority for Civil Information Data online to gather the what they need to fill out the table. 3. **Spatial Representation:** Students use Symbology features to visually show the population for each of Kuwait's provinces on the map. 4. **Population Growth:** Students will show the attribute table for population growth and discuss findings with their peers. 5. **Fieldwork:** Students will interview a grandparent to ask them about how the population of Kuwait has changed. They will ask them for their views about the underlying reasons for this change, and its consequences. Students will then insert their findings on their map by adding Map Notes. Students will also take pictures to help describe population growth in Kuwait and then share these images with classmates using the Geo-Form app.	* Draw polygon * Create attribute table * Show labels *Add fields *Symbology *Show map layers *Add map notes *Geo-Form app

(continued)

Table 21 *(cont.)*

Geographic Inquiry Steps	Question	Activity	GIS skills
Assess	As a demographer: Is population growth in Kuwait good or bad? Why? Provide some suggestions for controlling Kuwaiti population growth.		*Find and add data *Use configure pop-up tool to create bar chart *Use analysis tool
Act	**Action Phase: Writing Email** Write an e-mail to a city policymaker citing your ideas to control Kuwait population growth.		*Create story map journal

As described in Table 21, the project-based GIS activities engage students in three main phases; (1) Understand; (2) Assess; and (3) Act. The following section explains activities for each phase:

Understand phase. Students will work collaboratively to create a multi-layer map to understand how population has changed in Kuwait. To accomplish this, students will engage with the following five activities:

Activity 1: Create your own map. This activity will enable students to draw a map of Kuwait. To achieve this aim, students will create their own GIS map by using the editable feature in ArcGIS Online. Students will draw Kuwait's six provinces by using the polygon tool. After drawing their map, students will name each province by using 'add field' and 'create labels' tools. Students will add a text field for each province, and write down its name. They will then click on 'create labels,' and choose 'show name.'

Activity 2: Demographics. This activity will enable students to add data to their own map. Students will add fields representing five years: 1975, 1985, 1995, 2005, and 2015. For each year, students will add the following data: population number, birth, death, fertility, and migration rate. They will find this information on the Public Authority for Civil Information Data website. This activity aims to provide students with essential information which will enable them to identify the reasons behind population growth in Kuwait.

***Activity 3: Spatial representation*.** This activity will enable students to visualize population data. To accomplish this, students will employ the GIS Symbology tool, selecting "unique style." Within the "unique style" feature, students will choose a dark hue to represent a highly populated province, and the converse for a province with low population. Students will compare between provinces and select the provinces with the highest and lowest populations.

They will access the GIS attribute table and identify the reasons for these population numbers to answer the following question: “Do all governorates in your country have the same population? Explain.”

Activity 4: Population growth. The aim of this activity is to identify how population growth has changed over time in Kuwait. To achieve this goal, students will show the attribute tables, and click on each province to enter the following data from 1975 to 2015: births, deaths, population, fertility rate, and migration rate. Students will analyze the data and share their thoughts, ideas, and information with peers to enable them to answer the following question: “Have population numbers increased over 35 years? Why? Explain.” Students can also access google.com to learn more about the reasons for population increases in Kuwait over 35 years. Teachers should note that Kuwait’s population decreased in 1995 because many migrants returned to their countries of origin after the Gulf War. Students should focus on the migration rate as one of the big reasons for population growth in Kuwait.

Activity 5: Field trip. This activity will provide students with essential knowledge to identify the consequences of population growth in Kuwait. To achieve the purpose of this activity, students will perform two main exercises. In the first exercise, each student will interview a grandparent, or someone born before 1965, to ask them about how the Kuwaiti population has changed in their lifetime. They should ask for their views about the underlying reasons for these changes, and the resultant consequences. Teacher must also remind students to ask about how such things like the nation’s infrastructure, number of vehicles, traffic intensity, and congested areas have changed since 1975. Following their interviews, students will meet in their groups to share their findings and write a summary of their interview results. Students will then insert their findings on their map by adding Map Notes.

For their second exercise, students will take a picture that they feel best describes the Kuwaiti population. They will insert this picture in the map of Kuwait using the Geo-form app. The Geo-Form app enables students to share their images with geo-location in the map. Each student will see their classmates’ pictures and write a brief summary describing them.

Assess phase. Students will create a plan of action to address changes in population growth. As a group, students will discuss their opinions about population growth in Kuwait and whether any changes are needed.

Act phase. As demographers, each group will suggest a plan to control population growth in Kuwait based upon data in their GIS map. They will also propose changes to population distribution that would accommodate future population growth, then write an e-mail to a city policymaker describing these ideas. After finishing this task, each group will present their project to the class and take suggestions, comments and feedback from their teacher and peers.

After groups complete their project, they will create a brief presentation featuring their work. Students must follow the instructions and rubric outlined on the instructions sheet (see Appendix F6-Material C) to formulate this presentation, after which they will present it to the class. Following their lecture, each group will receive verbal feedback from their classroom peers via an in-class critique. Remind students to write these details down so that they can apply relevant revisions to their presentation and improve it. Once each group has updated their work, they must submit it to teacher for formal review.

Self and Peer Evaluation[*]. Each group member should fill out and submit their self and peer evaluation form (see APPENDIX F6-Material D) which teacher distributed earlier. This activity will encourage student involvement and sense of responsibility for their work. It will help them to reflect upon their role and contribution to the process of group work. It also allows them to evaluate the contributions of their peers, thus helping them to improve their judgment skills.

***Procedures for implementation*[*].** To implement the Taking Informed Action task activity, in-class instructions should be followed. To enable students to answer the Taking Informed Action questions, teachers will apply the following instructions:

1. Provide the project overview sheet (See Appendix F6-Material A) and step-by step instructions (See Appendix F6-Material B) to students. Students must read Materials A and B to properly understand the project's purpose and the activities it involves. They must then follow the instructions, answering questions for each activity.
2. Have students visit the website https://www.arcgis.com/index.html and log in to their accounts so they can start working collaboratively to complete project activities.

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[*] Self and Peer Evaluation activity was added.
[*] The section with procedures for implementing the Taking Informed Action task was added.

3. Inform students that they will have two 45-minutes class periods to complete the activities and answer associated questions. They will also have 45-minutes to prepare their presentation.
4. Once students complete their project, provide them with presentation instructions (See Appendix F6-Material C). Ask them to work collaboratively on this activity, and to use their work from previous activities to complete their presentation slides. Remind students to read the instructions carefully, and to review the rubric to make sure that their presentation fulfills all requirements. Inform students that they will have 5 minutes to present their argument and a further 5 minutes to receive commentary from their peers.
5. Students will revise their presentation based upon any relevant feedback they receive from classmates. They will then submit their work to the teacher. They must also complete both the personal and peer evaluation for their GIS group project form (See Appendix F6-Material D) and submit this to the teacher.

Facilitating AIW through the taking informed action task. This task was designed to engage students to work within groups on project-based GIS activities exploring the population growth topic in Kuwait by facilitating AIW criteria, rather than just learning the facts. Indeed, the social studies teacher, in teaching this task, should focus upon facilitating six AIW criteria: (a) construction of knowledge, (b) deep knowledge, (c) critical thinking skills, (d) elaborated communication, (e) collaboration and discussion, and (f) value beyond school.

To achieve this goal, students will execute five main activities. In summary, the first activity involves students using GIS to create their own map. They will then access Kuwait’s Public Authority for Civil Information Data website to gather the following information: population number, births, deaths, fertility rate, and migration rate for the following years: 1975, 1985, 1995, 2005, and 2015. Students will add these data to their map. In the third activity, they will use the GIS Symbology feature to visualize their data, enabling them to compare information between each of Kuwait's six provinces. Students will next interview a grandparent, or someone born before 1965, to learn how Kuwait’s population has changed, and what the resultant consequences are. Students will insert their interview findings on their map by using the Map Notes feature. And finally, students will take a picture which they feel describes the Kuwaiti population and share this picture with their peers using the Geo-Form app. These activities require students to work together to collect, analyze, interpret, and synthesize their data to understand population growth in Kuwait. This involves them heavily in higher-order thinking to construct deep knowledge, not to mention elaborated communication, collaboration and discussion with their fellow students; all critical AIW criteria. And finally, this task offers students the opportunity to connect the topic with their own, personal experiences by their discovery for how changes in population growth have affected their lives - offering the AIW criterion of value beyond school walls. Students will also communicate their ideas regarding population control in Kuwait, and send appropriate mitigation techniques to policymakers. These activities will all lead to increased student AIW and create a social interaction environment that will improve student learning.

Chapter Summary

This chapter described the final version of the GIS Instructional Model that resulted from the revision phase, with brief descriptions regarding revisions made. As noted in previous chapters, the model used IDM components and contained four main sections (1) staging of the Compelling Question task, (2) three Supporting Questions with Formative Performance Tasks and Featured Sources, (3) Summative Performance Task, and (4) Taking Informed Action. The model followed the six AIW criteria (a) construction of knowledge, (b) deep knowledge, (c) critical thinking skills, (d) elaborated communication, (e) discussion and conversation, and (f) value beyond school. Two experts reviewed the model to evaluate how well it meshed with these AIW criteria. The feedback from this expert review was used to revise and validate the model as presented in this chapter. Details regarding this feedback, and the subsequent revisions to the initial draft of the GIS Instructional Model are presented in Chapter 5.

CHAPTER 5
EXPERT REVIEW

An expert review process was used to validate the original draft of the GIS Instructional Model detailed in Appendix G. The review process, addressed in this chapter, was divided between a Formative Evaluation phase and a Usability Evaluation phase.

The formative evaluation phase sought to answer the study's first question: *How can a GIS instructional model be designed, from a pedagogical standpoint, to facilitate social studies inquiry and authentic intellectual work (AIW)?* Expert review feedback from this phase focused upon the validation of the GIS instructional model, which enabled the researcher to revise the model to better support AIW in the social studies classroom and thereby help improve its quality. The validation process sought to evaluate the original GIS instructional model to ensure that it achieved its purpose—namely, to facilitate AIW. Thus, the validation process focused on determining how well the GIS model supported the creation of AIW in social studies classrooms. Expert reviewers' feedback on this model will be used to determine the quality of activities supporting students' authentic work and to identify where additional development is required to improve it.

The usability evaluation process, on the other hand, concentrated on determining the model's usability within the context of its use in a Kuwaiti social studies classroom. The usability evaluation process seeks to answer the second question of the study: *What barriers exist for integrating this GIS Instructional Model into Kuwaiti social studies classrooms, and can anything be done to remove these obstacles?* In this phase, feedback was collected from six Kuwaiti experts. This helped to reveal potential barriers facing the model's implementation and to identify whether additional development was required.

As intimated earlier, this chapter has two main subsections which are devoted to: (1) formative evaluation results, and (2) usability evaluation results. Each subsection provides a description for how the various themes emerged, and then presents a discussion related to feedback associated with each theme.

Formative Evaluation Results

As already noted, the formative evaluation phase endeavored to validate the GIS Instructional Model. Two US expert reviewers agreed to conduct this assessment using a predetermined set of evaluation criteria (AIW criteria). Expert reviewer 1 is an authority on social studies education and IDM, while expert reviewer 2 holds expertise concerning the integration of GIS into social studies instruction.

The US reviewer participation took place in two stages. The first stage examined the online, open-ended survey with rubric to determine whether the model met the criteria for AIW. In the survey, open-ended questions provided experts with the opportunity to give specific feedback for each criterion. The survey was designed to determine how well the GIS model supports the creation of AIW in social studies classrooms. The second stage included follow-up conversations via face-to-face interview to clarify or expand upon reviewer survey comments. During these conversations, the expert reviewers produced valuable information and suggestions to improve the GIS Instructional Model. As already implied, the survey and interview questions were designed using the AIW framework described in Chapter 2. Both reviewers used the same survey and interview questions in their evaluation of the model.

Overall Perspectives

Feedback collected from the two expert reviewers varied in perspective, length, and detail. The breadth of this feedback proved to be of great value in revising the model. Following its collection, the feedback was analyzed. The themes generated during this analysis were determined by the focus of survey questions (Creswell, 1998). These questions concentrated upon six main AIW criteria which considered the common themes. The follow-up conversations centered upon these same themes, but gave reviewers the opportunity to offer observations and recommendations, based upon their own expertise and background, for improving the model's quality.

Broadly speaking, expert reviewer feedback from both survey and interview indicated that the GIS Instructional Model should have a positive effect upon student AIW. For example, Expert Reviewer 1 stated that, "I think this is a very strong inquiry," explaining that the model encouraged the construction of knowledge and critical thinking via the use of IDM. Expert Reviewer 2 stated that, "I think the unit is too ambitious," he did note that integrating GIS encourages students to discover the world from a spatial perspective. For instance, he found that GIS allows student users to construct knowledge about population growth, with the story map feature helping them to demonstrate their understanding. He further remarked that, "the strongest aspect of this activity is the activity that has students explore the different layers exhibiting the causes and effects of population growth." Expert Reviewer comments indicated that while the GIS Instructional Model was generally good, it required several revisions to facilitate AIW. Each Expert Reviewer provided an explanation and suggestions for improving the model to meet the six main AIW criteria: (a) construction of knowledge; (b) deep knowledge; (c) critical thinking skills; (d) conversation and discussion; (e) elaborated communication; and (f) value beyond school.

In the online survey's rubric, the Expert Reviewers were asked to evaluate how well the initial version of the model met each of these six AIW criteria, scoring from low to high. Table 22 shows an overview of these Expert Reviewer ratings. As is evident, both reviewers recorded that this model achieved only a medium level (neutral) score for the following AIW criteria: construction of knowledge, critical thinking skills, conversation and discussion, elaborated communication, and value beyond school. However, regarding the deep knowledge criterion, Expert Reviewer scores contradicted each other. Expert Reviewer 1 recorded a high level (positive) score in deep knowledge, while Expert Reviewer 2 found the opposite. The open-ended questions in the survey and follow-up conversations, however, provided more clarity concerning Expert Reviewer opinions, as well as their suggestions for improving this model. These will be discussed in detail in the following section.

Table 22

Expert Reviewer Scores in the Survey Rubric

Criteria	Expert Reviewer 1	Expert Reviewer 2
Construction of knowledge	Medium	Medium
To what extent does the GIS instructional model encourages students to construct their knowledge about world population growth?		
Deep knowledge	High	Low
To what extent does the GIS instructional model supports students in the construction of deep knowledge about population growth?		
Critical thinking skills	Medium	Medium
To what extent does the GIS instructional model encourages students to think critically (such as to organize, interpret, analyze, synthesize, or evaluate information)?		
Conversation & discussion	Medium	Medium
To what extent does the GIS instructional model encourages students to participate in discussions, arguments, and conversation?		
Elaborated communication	Medium	Medium
To what extent do the GIS instructional model encourages students to communicate with others verbally or in writing?		
Value beyond school	Medium	Medium
To what extent do the GIS instructional model relates to real-world issues beyond the school walls?		

Results Themes

The Expert Reviewers filled out open-ended questions in the online survey and took part in follow-up conversations to clarify the rubric scores. They identified several areas for improvement, and these fell primarily within the six AIW criteria. Each of the six AIW themes identified is addressed individually. For each theme, the Expert Reviewer's comments and suggestions are described, along with the commensurate revisions to the final draft of the GIS Instructional Model. Individually addressing each theme helped to ensure that all of the comments and suggested revisions were properly considered. It is important to mention that even though each theme is addressed individually, the themes do overlap which means that each criterion impacts one or more of the others. For example, ‘elaborated communication’and ‘discussion and conversation’have a positive impact upon ‘construction of knowledge’. Moreover, students construct their deep knowledge through their use of critical thinking skills.

Construction of knowledge criterion. The model is designed to facilitate the construction of knowledge. Through this model, students must learn by collaboratively building new knowledge upon the foundation of what they already know. Both Expert Reviewers indicated that the model achieved a medium level score in the construction of knowledge criterion. In the online survey, both Expert Reviewers had to answer the following question, *“Does the GIS Instructional Model encourage students in the construction of knowledge? Why or Why not?”* Both reviewers agreed that this model does facilitate the construction of knowledge. Expert Reviewer 1 answered positively, stating that, “Yes, this unit does encourage the construction of knowledge through the three formative performance tasks.” He indicated that students will build their knowledge by following the IDM-based inquiries and performance tasks. He also found that building an argument in the Summative Performance Task helps students to apply, “what they have learned in the process of constructing that argument to a taking informed action task.” Similarly, Expert Reviewer 2 positively answered that, “The unit definitely encourages students to construct knowledge about human population and human population growth.” He found that using the story map application for assignments, such as creating journal maps, helps students to construct their knowledge.

In follow-up conversations, the Expert Reviewers provided some suggestions to improve the model’s ability to satisfy the construction of knowledge criterion. Expert Reviewer 1 noted that inquiries, performance tasks, and sources should be well-structured to help students build their knowledge. He stated that, "We would like to look across the questions, the tasks, and the sources and ask ourselves whether the arrangement of those questions, tasks and sources was logical - whether they are connected together in a logical way." He found that the formative performance tasks in the model's initial version were not connected in a logical way; students were being asked to use a story map (Cascade format), then a mind map, and then again a story map (journal format). He felt that these unconnected tasks would be an obstacle to a student's ability to demonstrate their understanding of the content. He suggested that it would be better if a student starts working in a story map for the first formative performance task, and that they should end in the same format. For example, students could use one story map format (e.g. journal) in completing these tasks. This would help students to connect the information together more effectively, bringing deeper understanding for what they are investigating.

Expert Reviewer 2 noted that in the model's initial iteration, "a lot of your data is at the country level." For example, students are asked to discover the fertility rate, infant mortality rate, or population growth rate for Kuwait, Germany, Niger, and the US, and compare data between these countries. Such an isolated evaluation would only allow students to explore these concepts at a country level, without them necessarily making a connection between the results for their country, the countries immediately around them, and the region as a whole. He indicated that students should use GIS Map to investigate the population growth topic at different scales. For example, students could build relationships between their country, the region, and the world, or compare between their country and other parts of the world. But more apropos to the model under discussion, if students explore population growth in their country (Kuwait), they must then compare what they find with data for Arabian Gulf countries, with Arabian countries as a bloc, and with the entire world. Students will learn how to "construct" knowledge through making spatial connections with the information.

While both Expert Reviewers confirmed that the model did facilitate the construction of knowledge, they also felt it needed modifying to do so more effectively. As already noted, the follow-up interview process gave both Expert Reviewers the opportunity to expand upon their opinions and to provide advice for improvements; advice which the researcher reflected in model revisions.

Revision. The model now incorporates the following two revisions to better facilitate student construction of knowledge.

Formative performance tasks revision. The researcher modified the Formative Performance Tasks to flow more logically and to better help students to build their knowledge. Students will now work in just one story map journal format to show their understanding and make connections between information. For example, in Formative Performance Task 1, students will create a story map journal to answer the following question, *"How has world population growth changed?"* In Formative Performance Task 2, students will add slides to their journal to explain the causes of population growth. In Formative Performance Task 3, students will also add slides to describe the consequences of population growth. The story map journal will therefore become a single, more robust story that contains all answers to the supporting questions. This will help students to construct their knowledge by connecting new knowledge with prior knowledge. This revision is clarified in footnote number 1 in Chapter 4

Exploring population growth topic in different scales. Two activities received revisions to better engage students in discovering model concepts over different regional scales of population, rather than focusing solely at the country level:

1. Staging of the Compelling Question Task. This task changed completely during model revision; these changes will be discussed more expansively in the section for deep knowledge criterion. In the final version of the GIS Instructional Model, staging of the compelling question focused upon providing students with basic knowledge about the model's essential concepts, such as GIS, population growth, and human development. In this introductory task, students will explore population growth and human development index rates over different scales by using GIS maps for Kuwait, the Arabian Gulf, and Arabian countries as a bloc. They will also compare population growth rates between Kuwait and the world as a whole, and thus make connections, over different scales, to construct their spatial knowledge.
2. Supporting Question #2. The second activity (Acquire) was revised to involve students with discovering population characteristics over different scales. In the original GIS Instructional Model, students explored natural increase, fertility, and life expectancy rates, but only on a country-sized level. For example, students completed a table about natural population increase, fertility and life expectancy rates in Kuwait, Germany, Niger, etc. However, there is no spatial connection between these countries - students would just compare their country (Kuwait) to Germany in Europe or Niger

in Africa - and that inhibited the potential for deeper learning. Therefore, in the final GIS Instructional Model, students will explore natural population increase, life expectancy, and fertility rates for Kuwait, the Arabian Gulf, and Arabian countries as a bloc. They will also compare these data for the region's countries with those for the entire world. This revision is clarified in footnote number 5 in Chapter 4.

Deep knowledge criterion. The GIS Instructional Model is intended to facilitate deep knowledge. In the online survey rubric, the Expert Reviewers held contradictory views. As noted earlier, Expert Reviewer 1 indicated that this model achieved a "high" rating for improving a student's deep knowledge, while Expert Reviewer 2 evaluated this same performance as being "low". The following section should clarify the reasons behind this disparity in reviewer ratings.

In the online survey, both reviewers were asked to answer the following open-ended question, *"Does the GIS Instructional Model support the deep knowledge criterion? Why or why not?"* Expert Reviewer 1 answered, "If by deep knowledge, you mean that students have explored multiple dimensions of the content, then I would say yes." He indicated that the model would develop student knowledge by asking them to examine the historical trends of population growth, its effects, and outcomes. In contrast, Expert Reviewer 2 answered, "The support materials to help teachers and students develop deep knowledge about population growth is limited." From their responses, it is clear that each expert answered the question from their own specific perspective, interpreting the question's original intent quite differently. Expert Reviewer 1 focused upon the pedagogical content regarding how the model improved student knowledge in the population growth topic (e.g. historical changes, causes, and consequences). However, Expert Reviewer 2 focused upon how the model's supporting material (e.g. worksheets, step-by-step instructions, procedures, etc.) could develop deep knowledge.

Despite the significant differences between reviewer responses, the interviews provided clarity and rich feedback about the deep knowledge criterion, which helped the researcher to improve the model. The Expert Reviewer feedback can be divided into two main areas: (a) supportive materials, and (b) improvement of student deep knowledge. Both areas are discussed in the following section:

Supportive materials. Each reviewer provided feedback about the importance of supportive materials for teachers to enable students to develop their deep knowledge. In follow-up conversations, both reviewers agreed that adding supportive materials will help teachers to achieve success instructing this inquiry. Expert Reviewer 1 suggested that the model needed to add clear directions for "…what things the teacher would have to do in order to provide the elements of this model." He indicated that the model needs to add directions for how a teacher could both implement each task and improve student AIW, while also noting that teachers should know what they need to implement the GIS Instructional Model. He also suggested adding details to the model that discussed the appropriate classroom environment teachers would need to successfully instruct this model. More specifically, he highlighted that the model could describe, "…the physical arrangements of the room; what is the computer side; how much access to computers do you have; if there is a good wireless connection; how long is the class period…" He felt that adding these descriptions would help teachers to prepare themselves and their classroom environment to successfully implement the model.

Moreover, Expert Reviewer 2 suggested that all materials should be ready-to-use, stating that, "It should be something that's out-of-the-box; like a teacher picks it up and they don't have to develop new material to run your lesson." He explained that the materials he referred to included worksheets, step-by-step instructions, talking points, procedures, and presentation instructions. Expert Reviewer 2 also suggested that the materials should be well-organized and well-presented, with clear instructions to help teachers follow along easily, noting that a "very structured unit plan that includes all necessary materials" is required. This useful feedback led the researcher to add the suggested materials and clarifications to the final form of model.

Improvement of student deep knowledge. Both reviewers provided suggestions to improve student deep knowledge in the population growth topic. Although Expert Reviewer 1 recorded positive feedback for the model's performance regarding deep knowledge, he also provided some suggestions to improve the model's ability to satisfy this criterion. In the follow-up interview, he expanded upon how this model furthers student deep knowledge. He indicated that the model encourages a student's capacity to work with partners or within groups, elaborating that collaborative work enables students, "…to exchange ideas with each other, to take advantage of or distribute the knowledge." When asked for ideas to improve the model's ability to foster deep knowledge, he suggested that students needed to learn more about negative and zero population growth rate countries, noting that, "…the unit does not really support a critique of systems that support or limit population growth." He further suggested that, "assumptions about zero population growth could be examined," to deepen knowledge about population growth overall. He also noted that the model does not provide adequate information about the economic aspects involved with population growth, stating that, "There are limited economic factors being explored." In summary, Expert Reviewer 1 made two suggestions to improve the model's ability to promote student deep knowledge: (a) adding information about zero and negative population growth countries, and (b) adding information about economic aspects.

Meanwhile, as noted earlier, Expert Reviewer 2 recorded negative feedback for the model's performance regarding the deep knowledge criterion. In the online survey, he wrote that although the model focuses upon teaching with GIS, it neglects to engage GIS within the Staging of the Compelling Question activity. He felt it was important to develop a Staging of the Compelling Question activity that both introduces students to the key concepts of the inquiry *and* GIS technology. He noted in the survey, "I was surprised that your introductory activity on Kuwait did not utilize GIS." He suggested that the Staging of the Compelling Question could introduce students to the following questions, "What is GIS? How does GIS work? Why use GIS? What does GIS tell us about Kuwait?"

In the interview, he suggested that the model's original Staging of the Compelling Question (introductory activity) could be replaced with a story map journal activity. In this story map journal activity, students should be introduced to GIS and the model's key concepts to help them gain basic GIS skills and knowledge about the population growth topic before they start the inquiry. He also e-mailed the researcher with story map journal examples from his own work; this proved very helpful. In the follow-up conversation, Expert Reviewer 2 also indicated that the inquiry lacked information regarding human development, noting that students have to discover the human development index and how it is related to population growth. Students may also discover the social and economic indicators that imply development qualities. In summary, Expert Reviewer 2 suggested two model revisions to improve its performance regarding the deep knowledge theme: (a) replace the original Staging of the Compelling Question activity with a story map journal, and (b) add more information related to human development.

Revisions. All Expert Reviewer suggestions were considered and fully implemented in the updated model as follows:

Added and re-organized supportive materials. Three types of materials were added as follows:

1. Materials Box: In the final draft of the GIS Instructional Model, the researcher created a materials box (presented in Appendix F) with all required worksheets. These materials were designed to be ready-to-use and come complete with step-by-step instructions for teachers to implement the model. The materials box contains essential materials for each of the following tasks:
   - Staging of the Compelling Question task: Two materials added - a story map journal and a story map journal graphic organizer worksheet (see Appendix F1).
   - Supporting Question #1: Five support materials were added: (1) step-by-step instructions and questions sheet, (2) map journal instructions and rubric, (3) peer review activity sheet, (4) peer evaluation form, and (5) model of map journal for Supporting Question #1 (see Appendix F2).
   - Supporting Question #2: Five support materials added: (1) step-by-step instructions and questions sheet, (2) map journal instructions and rubric, (3) peer review activity sheet, (4) peer evaluation form, and (5) model of map journal for Supporting Question #2 (see Appendix F3).
   - Supporting Question #3: Five support materials added: (1) step-by-step instructions and questions sheet, (2) map journal instructions and rubric, (3) peer review activity sheet, (4) peer evaluation form, and (5) model of map journal for Supporting Question #3 (see Appendix F4).
   - Summative Performance Task. One support material re-organized: argumentative essay instructions. Two support materials added (1) argumentative essay evaluation form, and (2) model of argumentative essay (see Appendix F5).
   - Taking Informed Action Task: Two support materials re-organized: (1) GIS project overview, (2) step-by-step instructions. Two materials added (1) presentation instructions, and (2) self and peer evaluation form (see Appendix F6).
2. Procedures for Implementation: For each task, procedures were added which describe the essential instructions teachers should follow if they implement the model. These added items are identified with an asterisk (*) in Chapter 4.

3. Physical classroom environment description: a paragraph was added describing the desired physical environment needed to implement this model. This item is identified with an asterisk (*) in Chapter 4.

It is important to note that all materials, and the model itself, were re-organized to both improve their structure and make them easier for a teacher to follow. These material box documents are all presented in Appendix F. Added elements are identified with an asterisk (*) in Chapter 4.

Improving student deep knowledge in key concepts of inquiry. All reviewer suggestions were considered in this area; the following four main revisions are the result:

(1) Information about zero and negative population growth added as follows:

- Supporting Question #2: The fourth activity (Analysis) was revised to ask students to identify the characteristics of zero, negative, high, and low population growth rate countries. In the original GIS Instructional Model, students analyze the relationship(s) between the literacy and population growth rates. For example, students compare the literacy rate between high and low population growth countries. This activity was revised and expanded to engage students in discovering the literacy rates for nations clustered in four distinct groups of high, low, zero, and negative population growth rate. This activity contains two exercises. Firstly, students compare the literacy rates in four population growth rate groups: high, low, zero, and negative. They then investigate how the literacy rate varies for high, low, zero, and negative population growth rates. Secondly, students will also use Google to find and read articles about zero and negative population growth rate countries. They will then share and discuss this information with their partner. This revision is clarified in footnote number 7 in Chapter 4.
- Supporting Question #3. The fourth activity (Analyze) is designed to help students identify the economic and social consequences of population growth. In the original draft of the GIS Instructional Model, students discover the economic and social consequences (e.g. national income, unemployment rate, etc.) of population growth by comparing these factors in high and low population growth countries. For example, students compare the national income and unemployment

rates in high and low population growth rate countries. This activity was revised to help students to explore the consequences of population growth in four growth rate groups (high, low, zero and negative) instead of just those for high and low growth. This revision is clarified in footnote number 9 in Chapter 4

(2) Information about economic factors added: This revision was designed to enhance student exploration of economic issues related to population growth. As such, students will investigate both the economic factors which cause population growth, as well as those which result from it.

For example, students must examine how a nation's economic condition may affect its population growth rate. Poor countries, for instance, will have less ability to pay for health and medical services. This may cause more infants to die prematurely, which may then lead to an increase in the fertility rate, and therefore an increase in the population growth rate. Regarding the economic factors which are the result of population growth, students could investigate how high population growth may increase the pressure on a nation's natural resources, which in turn can lead to an increased poverty rate or decreased national economic growth.

To make the model adjustments to improve student examination of economic factors related to population growth, two GIS Instructional Model activities were revised as follows:

- Supporting Question #2. The fourth activity (Analysis) was revised to empower students to explore the economic factors as one of the causes of world population growth. In the original GIS Instructional Model, students add just two GIS layers (population growth and literacy rate) and compare between them to discover how literacy is related to population growth. To broaden the impact of this activity, the researcher revised and expanded its scope to help students explore the economic factors *behind* the literacy rate. As a result, in the final version of the GIS Instructional Model, students will create their own GIS layer, adding data for health expenditure, poverty and literacy rates for countries with high, low, zero, and negative population growth. Students will then determine the relationships between these data and learn that high population growth countries have high poverty rates and low health expenditures, while the opposite is generally true for low population growth countries. Students will also discover that the poverty rate has an indirect effect upon population growth. This revision is clarified in footnote number 7 in Chapter 4.

- Supporting Question #3. The fourth activity was revised to allow students to discover the economic consequences of population growth. In the original GIS Instructional Model, students add three GIS layers (population growth, national income, and unemployment rate) to investigate the consequences of population growth. This activity was revised and expanded to help students investigate more economic factors, such that in the final GIS Instructional Model, students create their own GIS map that contains the income growth, poverty, unemployment, and human development rates for high, low, zero, and negative population growth rate countries. Additionally, within the original GIS model, students just learn the national income rate, while in the final version, they will explore two economic factors (e.g. economic growth, and poverty rate). This revision is clarified in footnote number 9 in Chapter 4.

(3) Information related to development added as follows:

- Staging of the Compelling Question. This activity was completely changed to provide students with basic information about the model inquiry. In the original draft, the Staging of the Compelling Question task introduces students solely to the population growth topic. However, in the revised draft, this task requires students to learn about three topics: GIS, population growth, and human development. Students will explore the population growth topic as one of the essential concepts in this model. The final version of the GIS Instructional Model will engage students in two exercises to explore the human development topic. Firstly, students will read an article about the human development index to understand its definition. They will then explore the GIS human development map to understand the spatial variation of human development rates across the world. This revision is clarified in footnote number 2 in Chapter 4.
- Supporting Question #3. The fourth activity (Analyze) endeavors to help students understand the consequences of population growth. In the original draft, students only analyzed income and unemployment rates as consequences of population growth. However, in the final draft, this activity is revised and expanded to also

consider the human development index. Students will now explore economic growth, unemployment, poverty, and the human development index as consequences of population growth. They will also analyze how economic indicators (such as poverty and economic growth) as well as social indicators (such as unemployment) may effect the human development index. This revision is clarified in footnote number 9 in Chapter 4

(4) The Staging of the Compelling Question activity was completely changed, and will now involve a story map journal to introduce students to GIS and key model concepts (e.g. GIS, population growth, and human development). In the original draft of the GIS Instructional Model, teachers used images and charts to introduce students to the population growth topic. However, in the final draft, students will now use a GIS story map journal as a presentation tool with a graphic organizer worksheet. Students will interact with the story map by clicking on links that contain images, videos, articles, and GIS maps. They will work in pairs to engage with this story map journal and answer questions on the graphic organizer sheet. Through this activity with GIS, students will gain a basic understanding for the technology, which will include learning what GIS is, how it works, and why it's important. They will then explore GIS maps to understand the concepts of population growth and human development.

In summary, this activity was modified to introduce students to its three main concepts: GIS, population growth, and human development. This was instead of using more conventional means for introducing the population growth topic by asking students to compare between images and charts. This revision is clarified in footnote number 2 in Chapter 4.

Critical thinking skills criterion. A major goal in developing the GIS Instructional Model was to improve a student's ability to think critically in developing their understanding for content. Both experts gave the original model a medium rating regarding its ability to promote critical thinking. In the survey, both reviewers answered the following open-ended question "*Does the GIS Instructional Model encourage students to think critically; to analyze, compare, and interpret information? Why or Why not?*" Both Expert Reviewers gave positive responses. Expert Reviewer 1 stated that, "This unit does support critical thinking," explaining that this model encourages students to analyze and interpret information. Expert Reviewer 2 concurred stating that this model engaged students in, "analyzing, comparing, and interpreting information." He further noted that, "The strongest aspect of this activity is the activity that has students explore the different layers exhibiting the causes and effects of population growth." He felt that the model's ability to engage students in exploring multiple GIS layers would increase their thinking skills.

The follow-up conversations yielded more details regarding the model's ability to stimulate critical thinking. Both reviewers were asked the following question, *"If you were to implement this model, what changes would you make to improve student critical thinking skills, and how would you accomplish them?"* Expert Reviewer 1 began his answer by providing a clear definition of critical thinking skills, and noting how essential it is to engage students in the activities to develop their understanding for the content. Furthermore, he indicated that the model supports the critical thinking criterion, commenting that, "When I look at a lesson plan like you have… there are multiple places for students who will exercise these critical skills." He explained that the model involves students in many activities that require them to read maps, compare between maps, and understand the relationships between information. When asked for suggestions about revising the model to improve its critical thinking aspects, he answered, "I would not change anything, if you ask me, I would not change anything."

Expert Reviewer 2 came to different conclusions with his feedback, however. Although he recorded positive feedback in the survey, he indicated in the interview that GIS could be used to improve student critical thinking skills more deeply. He stated that most of the GIS activities in the original model only asked students to add GIS layers and compare between two or more GIS layers. In saying this, he noted that GIS provides many powerful tools for improving student critical thinking skills, and that these could be introduced into the model. For example, students should have to build their own GIS layer instead of just comparing between GIS layers. Students could also include editable features in their maps to create different types of layers (points, lines, and polygons), or use the Symbology feature to better their understanding of the spatial differences. GIS also provides a variety of analysis tools, the ability to insert images, or create charts to engage students with more advanced analysis of the data. In the follow-up interview, Expert Reviewer 2 also provided practical applications for many GIS tools that may be used in the model. The researcher worked together with the expert reviewer in the computer lab to gain practical experience with many GIS tools that could be included in the model. In this practical application, four GIS strategies were learned (a) using GIS analysis tools, (b) adding map notes, images, and features, (c) different kinds of symbology feature, (d) and creating GIS layers (points and polygon).

It is important to mention that the disparity in viewpoints between Expert Reviewer 1 and Expert Reviewer 2 was primarily due to the differences in their work experience and background. As Expert Reviewer 2 specializes with integrating GIS into the social studies classroom, it is understandable that his answers focused on *"…how GIS could be used to support critical thinking skills."* Expert Reviewer 1, however, focused upon improving critical thinking skills through the use of IDM, without much emphasis on the actual employment of GIS. This difference between expert views had value in improving the model, as each of them addressed it from a different perspective; the combination of their advice made the model stronger as a result.

Revision. The suggestions collected from Expert Reviewer 2 were considered and fully implemented into the model. All revisions were made with the proviso that they must help students to think critically to deepen their understanding about the population growth topic. The activities were revised to help students to use GIS to develop their critical thinking skills. Thus, the following six activities have either been expanded or replaced with more involved GIS activities:

Supporting question #1. The fourth activity (Analyze) was expanded to empower students to use GIS more intensively. In the original GIS Instructional Model (See Appendix G) students added the population layer "Global Population Changes in the 21st Century," and used the configure pop-up tool to convert numerical data into a bar chart. Students convert population numbers for 2015 and 2050 (predicted) into a bar chart to more easily notice the changes between these two dates. Students will also explore those countries that are expected to have a high 2050 population growth rate by discovering the data in the chart. However, in the final version of the GIS Instructional Model, this activity is expanded with the addition of an analysis tool element. After students convert the data into a bar chart and make comparisons to track changes, they will then use the GIS analysis tool to discover which countries will likely have populations in excess of one billion people by 2050.

Using such analysis tools will help students to learn the power of GIS and the possibilities it offers. Using spatial analysis tools (e.g. Find Location) extends a student's ability to visualize difficult to discern phenomena. Without these tools, it may be - for instance - challenging for students to determine which countries will have the highest population rates in

2050, or perhaps they might need too much time to find the information on the map. But by their use of GIS analysis tools (e.g. Find Location), students will be able to address questions critically and reach substantive information more easily and quickly through its visual representation. This revision is clarified in footnote number 3 in Chapter 4.

Supporting question #2. The following three activities were revised to engage students with critical GIS tools that will help them to think more deeply:

- Second activity (Acquire). This activity has two exercises. The second exercise was changed to prompt students to work more deeply with GIS to critically investigate the phenomena. In the original GIS Instructional Model, students use the configure pop-up tool to convert infant mortality data into a bar chart to compare rates for 2005 and 2015. However, in the final GIS Instructional Model, students will use the symbology feature to convert infant mortality rates into a heat map, rather than a bar chart, since students already used a bar chart when working on the fourth activity in Supporting Question #1. Employing the heat map tool, therefore, allows students to explore a new GIS feature that helps them to visually determine which countries have high infant mortality rates and where they are located. Heat map symbology will display the relative density of infant mortality; ‘cooler’ colors refer to a lower mortality rate density, while the ‘hotter’ colors refer to higher density. Using this feature will help students in their critical analysis of the relationships between infant mortality and location by comparing between countries. This revision is clarified in footnote number 5 in Chapter 4.
- Third activity (Explore): This activity has three main exercises, each of which received modifications to better engage students in their work with GIS to discover the causes of population growth. In the first activity, students investigate the relationships between population growth and birth rates. In the second exercise, students explore the relationships between population growth and fertility. In the third activity, students discover the relationships between population growth and life expectancy. In the original GIS Instructional Model, students just compare between GIS layers to investigate these relationships. However, in the final GIS Instructional Model, the revisions have students delve more deeply into GIS capabilities. For example, in the first exercise, students will use symbology (counts and amounts) and

transparency features to explore the relationships between population growth and birth rate layers. In the second exercise, students will also use symbology (counts and amounts) to investigate the relationships between population growth and fertility rate layers. In the same exercise, students will select a country with a high fertility rate, read about why this is so, and then add the collected information to their map using the map note tool. In the third exercise, students will compare between population growth and life expectancy layers. They will then select a country with low life expectancy, learn the reasons behind this fact, and again add the collected information to their map using the map note tool. This revision is clarified in footnote number 6 in Chapter 4.

- Fourth activity (Analysis). This activity was completely changed to encourage more critical employment of GIS to promote deeper student understanding for the causes behind population growth. In the original GIS Instructional Model, students add a GIS literacy rate map, read its included information, and then fill out the worksheet table. Students compare literacy rates for countries with high and low population growth rates. However, in the final GIS Instructional Model, this activity now engages students with building their own GIS layer by searching for, then adding, information and images into the GIS map to identify the characteristics of high, low, and zero population growth rate countries. Their GIS map will display population growth, economic growth, literacy and poverty rates. Students will also convert these data into bar charts to make the information simpler to interpret. This activity helps students to generate their content and create a visual representation of their collected information. Their own GIS layer will elucidate differences between nations, enabling students to explore the characteristics of low, high, and zero population growth rate countries. This revision is clarified in footnote number 7 in Chapter 4.

Supporting question #3. In the fourth activity (Analyze), students will build their own GIS layer by adding locations (points). They will create an attribute table to add information about unemployment, poverty and economic growth, rates, and then use Symbology to visualize the information and investigate the relationships between population growth, unemployment, economic growth and poverty rates instead of just adding and comparing between GIS layers. This activity will enable students to visually represent their information. Student will more easily explore the relationships between economic characteristics and population growth. This revision is clarified in footnote number 9 in Chapter 4.

Discussion and conversation criterion. The model seeks to facilitate discussion and conversation between students to improve their knowledge. Both reviewers gave a medium rating to the model's ability to meet the discussion and conversation criterion. To reveal more information about their scoring, both reviewers were asked to answer the following open-ended question: *"Does the GIS Instructional Unit encourage students to participate in discussions, arguments, and conversation? Why or Why not?"* Both Expert Reviewers responded negatively, agreeing that the model needs improvements to facilitate discussion and conversation. More specifically, Expert Reviewer 1 noted, "I do not see many opportunities for students to engage in discussion or conversations," while Expert Reviewer 2 stated, "It is hard to determine if there is encouragement for discussions."

In follow-up conversations, the experts' views became clearer, and they provided suggestions to strengthen the model's performance regarding the discussion and conversation criterion. Expert Reviewer 1 advocated two techniques, with the first being the 'feedback review,' where students can present their work and then have five minutes to receive feedback about their lecture from peers and/or teachers. The second approach Expert Reviewer 1 recommended was to, "… add another task for the student to engage in some discourse or discussion based activity." He clarified this by stating, "You could replace one of the four performance tasks with something more discussion-related." Expert Reviewer 2, however, suggested that there was simply a need to add directions to the model which clarify where and how the discussion should be facilitated.

Revision. The Expert Reviewers' suggestions were considered, and the following three revisions were made to the model as a result:

Feedback review activity added. In the Summative Performance Task, students will present their argumentative essay in a story map format and receive 5 minutes for a post-lecture feedback discussion. Moreover, in the 'take informed action task', students will present their project which will conclude with a 5-minute feedback discussion.

Discussion based activity. In the Summative Performance Task, students will construct their argument in discussion with their group members instead of doing so alone using the worksheet from the initial model version. This revision is clarified in footnote number 10 in Chapter 4.

Directions to facilitate discussion added. Materials and instructions were added to clarify where and how discussion would be facilitated, as mentioned earlier in reference to deep knowledge.

Elaborated communication criterion. The model aims to facilitate communication between students to enable them to construct shared knowledge. Both reviewers rated the model performance as medium for this criterion. For the purpose of clarification regarding their scoring, both reviewers were asked to answer the following open-ended question, *"Does the GIS Instructional Model encourage students to communicate and collaborate with others verbally or in writing? Why or Why not?"* Both Expert Reviewers gave positive feedback in their responses, indicating their shared belief that this model facilitates elaborated communication. Expert Reviewer 1 noted that the model provides opportunities for students to communicate with each other. For example, he found that the Summative Performance Task promotes student communication - especially through writing - stating that "Yes, the outcome (summative task) is a written argument." In addition, he found that, "The 'taking informed action' task provides another opportunity for students to write in an argumentative style." Expert Reviewer 2 emphasized that, "This project does a very good job encouraging students to communicate with others."

Although the reviewers agreed that the model performs well in facilitating communication and collaboration, they made some suggestions for improvements in the follow-up interviews. Both reviewers were asked, *"Could you think of a better strategy to foster communication and collaboration between students, and if so, what would that be, and how would you implement it in this model?"* Expert Reviewer 1 indicated that the feedback cycle would be a good strategy, especially for facilitating communication between students, noting that they can "…bring their work back to the whole group and share," to both give and receive feedback. Meanwhile, Expert Reviewer 2, who specializes in GIS, focused his suggestions on how to use the power of GIS tools to facilitate communication between students. He suggested that using the GeoForm app would promote inter-student communication. GeoForm is a configurable GIS application that enables students to share their collective data sets with one another. In offering his useful advice, Expert Reviewer 2 demonstrated how to use the GeoForm app during the interview.

Revision. The researcher considered the suggestions from both Expert Reviewers and revised the model as follows:

Peer review activity added. Four peer review activities were added in the following tasks: (1) Supporting Question #1, (2) Supporting Question #2, (3) Supporting Question #3, and (4) Taking Informed Action. Students will complete a peer review evaluation form to assess other student work. Each group has to send their own work to the other groups for assessment. Each group meets and then takes turns providing feedback to the other groups, as well as filling out a peer evaluation form. Four peer review activities were added.

GeoForm activity added. After students complete their field work in the Taking Informed Action Task (project-based GIS), they will take a picture that they feel helps to describe population growth in Kuwait. They will use the GeoForm app to share their pictures with peers. This revision is clarified in footnote number 11 in Chapter 4.

Value beyond school criterion. The model is designed to make connections between substantive knowledge and real world problems or personal experiences. Both reviewers indicated that the model achieved a medium level rating in the value beyond school criterion. To expand upon their evaluations, both reviewers were asked to answer the following question: *"Does the GIS Instructional Model relate to real-world issues 'beyond the school walls'? Why or Why not?"* The Expert Reviewers responded positively to this question, agreeing that the model helps students to make connections outside of school. For example, Expert Reviewer 1 stated that, "The taking informed action task is explicit in making connections outside of school/beyond the school walls." He added that in the formative tasks, "Students are using the ESRI platform that enables students to share what they have created with others outside of school." However, he did qualify this endorsement slightly - noting that" …part of the task just needs to be built up a bit," but without initially offering any advice on how to do so. In his response, Expert Reviewer 2 implied that the model related well to real-world issues as students worked with GIS to explore important topics such as, "…infant mortality rates, population density, deforestation, etc."

In follow-up conversations, the Expert Reviewers provided some clarity to their earlier survey statements. In particular, the researcher asked Expert Reviewer 1 to provide more details regarding his earlier response concerning, "…part of the task needs to be built up a bit." He related that there was a need to remove the word “problem” when talking about rapid population growth in the Taking Informed Action activity. He felt that students might infer population growth only has negative results, and thus bias their answers accordingly - when they should actually consider both sides of the argument. Therefore, Expert Reviewer 1 suggested changing the language theory to reduce chances of confirmation bias. Expert Reviewer 2 saw no need for changes to improve the model's ability to provide value beyond the school walls.

Revision. A modest revision was made to improve the model's performance in its value beyond school walls. The word “problem” was removed from the Taking Informed Action activity.

Other comments & suggestions. As the follow-up conversations were drawing to a close, each Expert Reviewer was asked, “Is there anything that needs to be added or changed? If so, what?” Each Expert Reviewer responded in ways that related to their own unique backgrounds and fields of expertise. Expert Reviewer 1 noted that the IDM table needed some revision to improve clarity, while Expert Reviewer 2 identified some technical issues related to GIS that needed adjustment. Both of their views are discussed in the following section.

IDM revision. Because Expert Reviewer 1 specializes in the IDM, he was able to provide useful advice for developing the model related to that teaching approach. Firstly, he suggested that the performance tasks should present the activities and tools that are used in creating the story map to answer each supporting question. For example, he mentioned that the performance tasks should describe the activities students will complete to answer the supporting question, stating that, “Your blueprint is the classics sort of language.” He also noted that clarification for performance tasks is needed, stating that, “I am looking at the table [IDM table], but it [the formative performance task] would have been something the teacher prepared, so she has to be prepared in the classroom to introduce the students to the story map.” Moreover, he indicated that the Summative Performance Task did not provide information about how the argument should be constructed. He asked, “What things do you do in this ‘constructing an argument’- The argument will be composed of what?” He emphasized that using clear language is important for giving teachers an optimal overview of model activities. Secondly, he found that the original blueprint for the model did not fully follow the IDM format. For example, the IDM table did not have the Staging of the Compelling Question task, and that the organization of model components differed from the original. He therefore suggested modifying it to do so. Based upon this feedback, the model blueprint was improved.

Technical issues. As Expert Reviewer 2 specializes in teaching with GIS and has practical experience with applying GIS in the classroom, he provided some suggestions of a technical aspect. Firstly, he suggested using a story map journal format in Supporting Question #1 instead of Cascade. During the interview, he noted that Cascade is a “challenge” because it “…is just a waterfall. It just keeps going down.” He said students will face difficulties when they work with it. He suggested, “A good tool that I use is offered free with the map journal.” He mentioned that the map journal enables students to insert visuals easily, and shows maps with space for writing. Moreover, he also suggested using ArcGIS Online in the final task (GIS-based project) instead of ArcMap. In the survey, he stated that, “ArcMap is very cumbersome and difficult to load onto computers…[and] ArcGIS Online requires no software install.” During the interview, he said that ArcMap was a very large piece of software that needs a computer and significant time to upload. He also said that ArcMap is difficult for teachers and students to use, and that ArcGIS Online is easier and can satisfy any classroom requirements.

Revision. Both Expert Reviewer suggestions were considered and model revisions were made as follows:

Revised IDM table. Three Formative Performance Tasks and a Summative Performance Task were revised to more clearly reflect how activities should be completed to answer the supporting and compelling questions. Table 23 describes these performance task revisions. The IDM blueprint was also replaced with the original format. This revision is clarified in footnote number 1 in Chapter 4.

Table 23

Performance Tasks Revisions

Performance tasks	Before	After
Formative Performance Task 1	Create a Story Map (CASCADE Type) shows how the world's population has changed over time.	Use GIS tools (e.g. timeline bar, configure pop-up, and analysis) to identify how population has changed with time and location, and create a Story Map Journal to demonstrate work and answer the supporting question.
Formative Performance Task 2	Create a Mind Map that shows the causes of world population growth (group work).	Compare multiple layers in GIS maps using Symbology features, build your own GIS layer to demonstrate the causes of rapid population growth, and adding slides to their created journal to show work and answering the supporting question.
Formative Performance Task 3	Create a Map Journal that shows the consequences of rapid population growth in the world	Add GIS maps on a 3D imagery scene and create your own GIS map by adding points, creating an attribute table, and using Symbology features to understand the consequences of population growth and adding slides to their created journal to show work and understanding of supporting question.
Summative Performance Task	**ARGUMENT:** Is population growth good or bad for human development? Construct an argument that discusses both viewpoints by using the story map application.	**ARGUMENT** Is population growth good or bad for human development? This will be a discussion-based activity (work in groups) to construct an argument that addresses both the positive and negative sides of population growth using specific claims and relevant evidence from GIS maps while acknowledging competing views. The argument will be created in the Story Map format.

Technical Issue Revisions. The researcher made the following two model revisions to make it easier for students to engage and work with GIS:

- In the last activity (Act) for Supporting Question #1, students will create a Story Map Journal instead of using the Cascade format.
- In the GIS-based project, students will complete their activities using ArcGIS Online instead of ArcMap.

Although these revisions did not relate to AIW criteria, they did lead to increased model quality. Revising the IDM will help to provide social studies teachers with clear insight and an overview of the inquiry. Adding explanations to the performance tasks will help the teacher to better understand what activities they should engage in to help students answer the supporting questions. Moreover, the technical issue revisions will help teachers and students to work with GIS more easily. The first revision, as already noted, will mean students use the Story Map Journal format instead of Story Map Cascade to demonstrate their understanding. The Story Map Journal format will help students to present their understanding more clearly through being able to easily insert maps and images. And regarding the use of ArcGIS Online, it will be easier than ArcMap to integrate successfully into social studies instruction

Usability Evaluation Results

While US experts provided valuable feedback for improving the model, their different cultural/work environments and/or educational policies may have biased these data regarding the model's effectiveness in Kuwait. To address this challenge, the researcher e-mailed the final GIS model, along with a usability evaluation survey, to reviewers in Kuwait. This helped to identify potential barriers against the model's successful incorporation in a Kuwaiti school context, and provided suggestions to possibly overcome these obstacles. In this phase, six Kuwaiti Expert Reviewers agreed to review the final GIS Instructional Model using a predetermined set of evaluation criteria. To participate in this evaluation, the Kuwaiti Expert Reviewers had to possess at least a decade of social studies teaching experience, and practical experience applying technology in their classrooms. Through this phase, the Expert Reviewers are identified using the designators T1 through T6. For example, T1 indicates Social Studies Teacher 1, T2 refers to Social Studies Teacher 2, and so on.

The review was conducted via an online survey, which consisted of predetermined criteria rubric and open-ended questions to provide additional feedback/suggestions. The predetermined criteria focused upon the four major barriers that may affect the GIS Instructional Model's implementation phase: (a) time (instructional and preparation time), (b) information technology infrastructure, (c) teacher preparedness, and (d) curriculum structure and policy. This section begins by describing the demographic details for each Kuwaiti expert selected to participate in the GIS model review. Survey rubric data and data analysis for the open-ended questions are also discussed.

Kuwaiti Expert Reviewer Demographic Information

Six Expert Reviewers agreed to voluntarily participate in the study. While each of them has a minor prior acquaintance with the researcher - either when teaching in Kuwait, or during undergraduate study - it must be stated that they are not close colleagues or friends. . They are all social studies teachers with experience integrating technology into the classroom. As noted earlier, the researcher e-mailed the survey to each expert along with the final version of the GIS Instructional Model. Each expert filled out the rubric with open-ended questions to clarify their thoughts regarding barriers to the model's implementation in Kuwait, and suggested potential solutions for overcoming these impediments. Six surveys were collected and analyzed. The survey began by asking the experts to list some of their personal demographics including their gender, years of teaching experience, subject taught, grade taught, and prior experience with GIS. Their responses are listed in Table 24.

Table 24

Expert Reviewer Demographic Profiles

Expert	Gender	Experience (years)	Education Level	Subject	School	Grade Taught	Works with GIS	Applies GIS in Classroom
T1	F	10	BSc Education/Geography	Geography	High School	10 & 12	NO	NO
T2	F	14	BSc Education/History	History	High School	10	NO	NO
T3	F	10	BSc Geography	Geography	High School	11	YES	NO
T4	F	17	BSc of Geography	Geography	High School	11 & 12	YES	NO
T5	F	11	BSc & MSc Geography	Geography	High School	11 & 12	YES	YES
T6	F	21	BSc Education/Geography	Geography	High School	12	NO	NO

It is important to clarify the experts' demographic characteristics and prior experience before reviewing the survey results. The social studies teachers who participated in this phase worked at four separate high schools. T3, T4, and T6 worked at the same school, while the others each worked at a different location. The social studies teachers are divided into two groups: those with a Bachelor's degree in education (with a specialization in either geography or history), or those with a geography degree from Social Sciences College. Indeed, within Kuwait, individuals who want to work as geography or history teachers must hold either a Bachelor’s degree in education (with a specialization in geography or history), a Bachelor’s degree in geography from a Social Sciences College, or a Bachelor’s degree in history from the Liberal Arts College. Teachers who graduate from Social Sciences College or Liberal Arts College do not have a background in education or teaching methods, since these were not part of their curricula. As a result, once hired as teachers, they usually spend the first month of their professional career in observation, and training under either experienced teachers or the head of their school’s social studies department.

Table 24 shows that three teachers hold a Bachelor’s degree in education, while the others have geography degrees. The latter three have prior experience with GIS, as the Geography Department in Social Sciences College provides at least two classes in GIS for their students. This is in contrast to Education College, which offers no GIS classes of any kind. But, as can be inferred, it is normal for teachers who graduate with geography degrees to have some level of GIS experience. Even so, it is important to note that these geography graduates only learned how to use GIS from a technical perspective during their training, rather than how to employ the technology as an instructional tool to enhance student learning in their future teaching practice. Indicative of this deficiency, only one Expert Reviewer has actually applied a rudimentary type of GIS technology (Google Earth) in her classroom.

Overall Perspectives

Broadly speaking, feedback from the Kuwaiti Expert Reviewers indicated that they thought the final GIS Instructional Model would be an effective tool for teaching geography content in Kuwait. For example, one of the Expert Reviewers (T2) stated that, “In general, I think this model is interesting, and provides good teaching materials; you did a good job.” Adding to this, another expert (T3) stated, “This unit will work well for me,” while yet another (T5) explained that, “The combination of GIS with geography content is powerful… and using ArcGIS Online without needing to install software was positive.” However, while the Expert Reviewers were generally positive regarding the GIS Instructional Model, they also indicated that several challenges would need consideration. Each Expert Reviewer provided descriptions regarding the following four obstacles that they perceived might hinder model implementation:

(a) instructional and preparation/practice time), (b) information technology infrastructure, (c) teacher preparedness, and (d) curriculum structure and policy. They also made suggestions for overcoming these obstacles.

Table 25 shows an overview for each Expert Reviewer's perceptions regarding which areas would present barriers to the GIS Instructional Model. In general, these results indicate that there are several impediments to overcome before the model can be implemented. School infrastructure appears to be the biggest challenge, with all six social studies teachers (N=6) agreeing that it needs improvements. Four teachers (N=4) indicated that time and curriculum barriers will present problems, while three (N=3) felt that teacher preparedness was inadequate.

Table 25

Barriers to GIS Instructional Model Implementation

Obstacles	T1	T2	T3	T4	T5	T6
Time	x		x	x		x
School Infrastructure	x	x	x	x	x	x
Teacher Preparedness	x	x			x	
Curriculum Barriers	x	x	x		x	

The Expert Reviewer responses to the open-ended questions provided a deeper understanding for their comments and suggestions about the four obstacle themes. The following section will explore each theme in detail with the appropriate supporting expert opinions.

Resulting Themes

The six Expert Reviewers answered the open-ended questions to clarify their rubric scoring. They provided an explanation for each theme (barrier), and identified possible solutions for overcoming them. Each of the four identified themes is addressed individually, and coupled with the applicable Kuwaiti Expert Reviewer opinions and suggestions. Individually addressing each theme helped to ensure that all relevant comments and suggestions were discussed.

Time: Time is an important factor regarding the GIS Instructional Model's successful implementation. This theme focused upon Expert Reviewer concerns about whether teachers would have enough available time to implement the model in their social studies classrooms, and what could be done to address this potentially thorny issue. In the survey rubric, four of the six Expert Reviewers responded in the negative. To better understand their responses, all six Expert Reviewers answered the following question, "*Is there adequate time to implement the GIS Instructional Model? Why, or Why not?"*

Their feedback addressed the question from two different perspectives: (1) instructional time - i.e. the time needed to implement the model in a classroom context; (2) preparation time - i.e. the time needed to prepare both themselves and their students to implement the model. Four experts related their answers to available instructional time, while the other two couched their responses in terms of preparation time. As one could infer from above, two Expert Reviewers agreed that teachers would have sufficient instructional time (classroom periods) to implement the GIS Instructional Model. Reviewer T2 stated that, "The model is flexible to reduce activities," noting that she found several places where procedural steps could be changed, or even removed, in order to reduce time constraints. In acknowledging that teachers would have enough instructional time to integrate the model, Reviewer T5 stated that, "In general, the grade 12 textbook is short, and the time [available to teach it is] always excessive."

However, four Expert Reviewers felt that both instructional and preparation time constraints may hinder GIS Instructional Model implementation. Two of these experts (T4 and T6) were concerned about available instructional time. They noted that the model has a lot of activities, and that there may not be enough class periods to explore the entire model. For example, T4 stated that, "I think the class periods will not be enough to cover all activities in the model." Moreover, two expert reviewers (T1 and T3) registered concerns regarding preparation time for teachers and students. Expert Reviewer T1 noted that, "Students may need more time to understand how it works, as this is the first time they will use GIS." She stressed that students should have sufficient time to practice and become familiar with GIS, adding that, "Students should have the basic GIS skills and knowledge before they implement this model… This will help to reduce the time [needed to implement the model]." Supplementing this consideration, Expert Reviewer T3 suggested that teachers would need time to practice and prepare themselves before implementing the model, stating that, “We need time to practice - even though I have experience in GIS… and we need time to teach students to use GIS.” She further noted that teachers would need time to read the model carefully, understand its instructions, and then practice running through the model’s GIS activities themselves before implementing them with students in class.

The Expert Reviewers were asked to offer ideas which might mitigate these potential time constraints; two of them responded with suggestions. Expert Reviewer T1 stated that, “The teacher should expect this model will need more time… [so they] should create a plan to determine what activities they will remove or reduce spending time on.” In other words, she felt that teachers could create a plan to adjust the model to fit their timeline by reducing the activity load, or decreasing the time allocated to each activity. Expert Reviewer T3 addressed the teacher’s limited preparation time, by suggesting that, “ Aone day workshop will help a teacher to gain the basic skills to implement the model.” She indicated that this teacher training with a GIS expert would also help reduce class preparation time.

Information technology infrastructure: IT infrastructure refers to the basic facilities and equipment which are needed to implement the GIS Instructional Model. It comprises the technological devices (computers, laptops, tablets…etc.), software, network connection, and the electricity to power them. To implement this model, schools must be well-prepared with a reliable, high speed internet connection available, as well as the technological devices to employ GIS. In the rubric, all six teachers (N=6) indicated that school IT infrastructure will present a challenge. To provide their views and suggestions about school infrastructure, the Expert Reviewers were asked the following open-ended question: *“Are the schools in Kuwait prepared to integrate GIS in their classrooms? Why, or why not?”*

All teachers indicated that even if a number of Kuwaiti secondary schools now have computers and Wi-Fi, one should expect problems with internet connections and the limited capabilities of available technological devices at some locations. One reviewer (T3) confirmed this, noting that, “We do not have a Wi-Fi connection and laptops.” Another reviewer (T5) stated that, “Having one computer per student is still a dream… maybe in the future.” Four reviewers provided suggestions to address this significant challenge, but all of these comments centered upon the need for schools to have an internet connection along with the appropriate technological devices to implement the model. One reviewer (T1) proposed, "Maybe teachers can use the computer lab if it is available," while (T4) suggested that, "Teachers could ask students to bring their own phones or iPad," to address this challenge. Reviewer (T5) also intimated that if students worked in groups, they would need fewer technological devices, stating that, "Working in groups will require just six devices."

Teacher preparedness: Teacher preparedness and training is clearly necessary to implement the GIS Instructional Model. This theme explored the readiness of Kuwaiti social studies teachers to use GIS and implement this model. In the rubric, three Expert Reviewers indicated that teachers do not have the knowledge or skills to use GIS in their classrooms. In the open-ended questions, teachers were asked to answer the following question: *"Are teachers able/prepared to use GIS in their classrooms? Why, or why not?*

Reviewers provided positive feedback for this theme. One of them (T4) commented that, "Everyone uses the Internet now, and the model is easy." She indicated that teachers who are familiar with the internet or use smart phones will be able to implement this model. Another teacher (T6) stated that, "The instructions are clear; you just need to follow them and practice," indicating that the GIS Instructional Model's step-by-step instructions with illustrative images were helpful.

However, despite the positive feedback from three Reviewers, three of their colleagues disagreed, with one of them (T1) commenting that, "Many teachers have not worked with GIS before… I have not used GIS before." She further noted that her pre-service teacher training program did not provide GIS-related classes, stating, "I do not remember taking any class related to GIS when I studied [for my Bachelor's degree]. *"*Another Reviewer (T5) noted that, "Social studies teachers are not familiar with GIS…" She further stated that, "I do not see any of my colleagues use GIS." Moreover, Expert Reviewer T3 indicated that she believed most Kuwaiti social studies teachers have no background in GIS. She also expressed concern that even if some were able to work with GIS, "…technical issues may occur," and teachers would have difficulty dealing with them.

In general, the Kuwaiti Expert Reviewers indicated that both pre-service training programs and in-service professional development courses do little to prepare social studies teachers for integrating GIS into their classrooms. As mentioned earlier, Kuwaiti social studies teachers are generally divided between two groups: teachers with Bachelor's degrees in geography, and teachers who hold a bachelor's degree in education with a *specialization* in geography. Only those with geography degrees received any measurable exposure to GIS during their training, but even this focused solely upon the technology itself, rather than its application in a classroom context to improve student learning. Moreover, there are no readily available GIS training courses or workshops to provide in-service teachers with the knowledge and expertise for how to integrate GIS in social studies classrooms.

As a result of these evident barriers to model implementation, the Reviewers were asked to suggest some mitigation techniques to help overcome them. One Reviewer (T2) stated that, "Workshops with the application will be very helpful." Indeed, almost all of the Reviewers indicated that small GIS workshops or training courses would be a good solution for bringing teachers up to speed with the technology. Expert Reviewer (T3) indicated that teachers should also be mindful of the potential technical problems and remember how to solve them, adding that, "Someone who has experience in technical issues is required to help teachers if they face problems."

Curriculum structure and policy. Kuwait's curriculum structure and policy is considered an impediment to implementing the GIS Instructional Model. This theme focused upon exploring the flexibility of the Kuwaiti social studies curriculum structure, and its ability to absorb the use of GIS in classroom practice. In the rubric, four Reviewers indicated that the curriculum is highly standardized and provides no opportunity for including GIS. To better understand the Expert Reviewer opinions regarding this theme, the researcher asked them to answer the following question: *"Does the curriculum encourage teachers to use GIS in their classrooms? Why, or why not?"*

Two Reviewers responded positively, with one of them (T4) stating that, "Yes the curriculum encourages using technology." She also found that the GIS Instructional Model would help support the integration of technology in the classroom, and support the achievement of national curriculum goals. Another Reviewer (T6) stated that, "If it is possible to use GIS… it would be great." She also felt that the integration of GIS would provide potentially significant support for student learning and that Kuwaiti curriculum standards and policy would not hinder

GIS integration. Indeed, she further stated that, "I love to integrate technology in my classroom… I always found encouragement from my boss."

In contrast, the other four Expert Reviewers provided negative feedback on this theme. They concluded that there are two main curriculum-related barriers that may hinder model implementation: (1) a lack of awareness about GIS, and (2) the traditional grading system. Two experts (T1 and T3) indicated that the major challenge is the limited knowledge among educational stakeholders and policymakers about the capabilities that GIS can contribute to social studies teaching and learning practices. Expert Reviewer T1 stated that, "No one [educational stakeholders] mentioned about using GIS." She felt that this omission occurred because many educational stakeholders and policymakers have no background in GIS, and may not even know what GIS is. She indicated that broadening understanding amongst these key participants regarding the potential benefits of GIS classroom integration will definitely help facilitate its implementation. From another perspective, one reviewer (T2) noted that the traditional grading system may impede model implementation stating, "The curriculum asks us to focus on tests… there is no space [for implementing GIS]." She continued her explanation saying that with the current Kuwaiti curriculum requirements, "Teachers should teach certain topics to students that enable them to pass tests." In other words, the grading system in Kuwait pays far less attention to project-based learning or research, choosing instead to prioritize helping students memorize and retain information for tests. As a result, teachers spend the majority of their time focused upon drilling students with the important facts and information they will need to achieve high test grades. But such techniques, while useful to some students in the short term, do not necessarily promote true understanding for the facts themselves (unlike the GIS Instructional Model which does help students in this endeavor). Expert Reviewer T2 noted the GIS Instructional Model does not focus on information, but rather on student projects or work, and this will not necessarily help students to pass the standardized tests which rely more on memorization.

Two Expert Reviewers did provide palliative remedies though, suggesting that: (1) an increase in educational awareness about the benefits GIS brings, and (2) revisions to the grading system; de-emphasizing standardized tests in favor of student projects. Indeed, Expert Reviewer (T3) noted that, "Educational stakeholders should increase teacher awareness on the importance of GIS." She emphasized that *if* educational stakeholders and policymakers *believe* in the potential that GIS holds, they will work hard to embed the technology in curriculum standards, which will also inevitably result in their providing short training courses and workshops to help facilitate said integration. Another reviewer (T2) averred the importance of changing the grading system to facilitate the integration of GIS in general, and this model in particular. She observed that it would be possible to implement the GIS Instructional Model by de-emphasizing standardized tests in the curriculum requirements in favor of student work, noting that, "If we want to implement this model, we have to not focus on the test, but focus on the project and student work, and give less marks to the test." She indicated that this idea could be implemented by educational policymakers and stakeholders.

Usability Evaluation Results Summary

Feedback from Kuwaiti Expert Reviewers helped to identify potential barriers against the GIS Instructional Model's successful incorporation in a Kuwaiti school context, and provided suggestions to help overcome these obstacles. The Reviewers indicated that there are four challenges to implementing this model in Kuwaiti classrooms (1) limited instructional and preparation time, (2) inadequate information technology infrastructure, (3) insufficient teacher preparedness, and (4) curriculum structure and education policy rigidity. The potential solutions which the Reviewers suggested might overcome these obstacles are outlined in Table 26 below. Identifying the challenges and their potential solutions should help to successfully implement the GIS Instructional Model. Indeed it is important to consider all potential obstacles that may diminish the model's effectiveness. After-all, it is the successful implementation of this model that will help achieve the purpose of this study, and that is to facilitate Authentic Intellectual Work (AIW) in the social studies classroom. For example, if one can successfully address the time issue, or sufficiently improve teacher preparedness for implementing this model, it will help the model to succeed, which in turn will help facilitate AIW criteria in the classroom.

Table 26

Overview of GIS Instructional Model Implementation Barriers and Suggestions

Criteria	Description	Barriers	Potential Solutions
Time	Minimal available instructional time and preparation time to integrate GIS into classrooms.	Limited instructional time	• Reduce the activities load • Create a plan to revise the model timeline and activities.
		Limited preparation time	• One day workshop
IT Infrastructure	Schools are marginally prepared with information technology infrastructure to use GIS in their classrooms.	Limited technological devices, no internet or Wi-Fi connection.	• Prepare schools with internet and computers • Use the computer lab • Ask students to bring their own phones/tablets to class • Using group work to decrease the required number of technological devices
Teacher Preparedness	Social studies teachers do not have the knowledge or skills to use GIS in their classrooms.	Lack of pre-service teacher preparedness	• Practical workshops • Short training courses
		Lack of in-service teachers preparedness	• Integrate GIS in instructional technology course or providing GIS in education course
		Technical problems	• Need for a technical assistant to fix technological problems
Curriculum Structure and Policy	Kuwaiti curriculum is highly standardized and provides no opportunity to use GIS in classrooms.	Lack of awareness	• Increase educational stakeholder awareness for importance of GIS
		Traditional grading system	• Change grading system, focusing more on projects.

Chapter Summary

This chapter described the results from the formative and usability evaluation phases. Feedback from the formative evaluation process helped to revise the original draft of the GIS Instructional Model to increase its quality. Feedback from the usability evaluation phase helped determine perceived barriers for the model’s future implementation, and provided suggestions to overcome these barriers. This document’s final chapter contains a study summary, along with a discussion regarding the GIS Instructional Model’s final draft - its limitations, contributions and future direction.

CHAPTER 6
SUMMARY AND OBSERVATIONS

This chapter provides a summary of the developmental study and describes its limitations. It also illustrates this study's contributions to the field of social studies and provides recommendations for future research and practice.

Study Summary

There is currently a lack of guidelines or models which demonstrate ways for integrating GIS into social studies classroom practices in support of student learning. This study attempts to address this gap in the literature by developing a practical, theoretically-grounded, GIS Instructional Model that explains how to integrate GIS into classroom practices in the support of student authentic intellectual work. As such, it offers a unique contribution to the field. Furthermore, this study makes another contribution by closing the gap between theoretical research and its practical application. It provides a practical example for how GIS could be used to perform inquiry to facilitate AIW in social studies classrooms. It helps social studies teachers to gain the knowledge they need for how they can connect educational theories, such as IDM and AIW criteria, with their technologically-driven practice or application.

This study makes another contribution by essentially breaking new ground for Kuwait. The nation's educational system has yet to employ GIS to any significant degree, and the work presented here could help change that situation by providing a platform to both introduce the technology and make it easier to integrate within social studies instructional practices (in a Kuwaiti classroom context). The model also helps to demonstrate the potential benefits GIS offers in the social studies classroom, not to mention its affordability. Furthermore, the researcher anticipates that this GIS model, through its implementation, will help social studies teachers to gain the basic knowledge and skills they will need for employing the technology.

Moreover, this study also adds to the body of knowledge regarding the methodology of developmental research, serving as a model for using this approach to advance the discipline's instructional practices. Beyond simply using design and developmental research methodology, this study went further by blending international voices into the end product. Indeed, the integration of multifaceted perspectives and experiences from both Kuwaiti and US-based experts helped to improve the model and strengthen its foundation. This study can therefore serve as an example for future social studies educational research in how to weave multinational expertise into a design and developmental approach to building an instructional model.

The purpose of this study was to design, develop, and validate a GIS Instructional Model for social studies teachers to facilitate AIW in Kuwaiti classrooms, with the following AIW criteria being key elements: (a) construction of knowledge; (b) deep knowledge; (c) critical thinking skills; (d) elaborated communication; (e) discussion and conversation; and (f) value beyond school. Two questions guided the study:

RQ1: How can a GIS Instructional Model be designed, from a pedagogical standpoint, to facilitate Authentic Intellectual Work in social studies classrooms?

RQ2: What barriers exist for integrating this GIS Instructional Model into Kuwaiti social studies classrooms, and can anything be done to remove these obstacles?

In order to accomplish its purpose, and to answer the research questions, the study employed a Type 1 developmental research design (Richey & Klein, 2007), with the following five phases: (a) selection of model components and theoretical foundation; (b) analysis and development; (c) formative evaluation; (d) revision; and (e) usability evaluation.

The first four phases in the developmental study's procedure helped to answer the first question: *"How can a GIS Instructional Model be designed, from a pedagogical standpoint, to facilitate Authentic Intellectual Work in social studies classrooms?"*

During the study's initial phase, the IDM format and components - developed by Grant et al., (2017) - along with AIW criteria (Newmann et al., 2007) provided the foundation for creating the original draft of the GIS Instructional Model. The succeeding phase involved an analysis of ESRI's GIS lessons for social studies teachers. The researcher applied the information gleaned from this exercise, in combination with personal experience using GIS, to create the original GIS Instructional Model. As intimated earlier, this model followed the IDM format while also including AIW criteria. The resulting original draft of the GIS Instructional Model measures less than a teaching unit, but more than a lesson in length; it comprises several lessons and comes complete with all necessary teaching materials and instructions. The model was designed and developed to be a ready-to-implement tool for supporting AIW in social studies classrooms.

Once the researcher had created the original draft, the model required appraisal via the formative evaluation phase. Two experts conducted a review to determine how well the model would support the creation of AIW in social studies classrooms. These Expert Reviewers participated in an online survey and follow-up interviews to record their opinions about the model, and to offer suggestions for its improvement. The survey asked the experts to complete the rubric and answer open-ended questions specifically tailored to determine the model's effectiveness for supporting AIW criteria. In the follow-up interviews, the Expert Reviewers provided explanations for their responses and offered suggestions for improving the model.

This feedback helped to identify which model features required additional development, along with methods for improving them. Based upon Expert Reviewer feedback, the researcher was able to validate the model and create a plan for revising it. However, having feedback from just two experts can lead to contradictory opinions and suggestions regarding model revision. Anticipating such a possibility, the researcher employed two different data analysis techniques to address this concern: the Analytic Memo and the Constant Comparative Method. As a result, the researcher was able to create a plan for areas in the original GIS Instructional Model that needed improvement/revision. This revision phase included consideration for all reviewer comments, opinions and suggestions. The reviewers' valuable feedback, based upon their expertise and knowledge, focused upon how the model could be improved to facilitate the following AIW criteria (a) construction of knowledge, (b) deep knowledge, (c) critical thinking skills, (d) elaborated communication, (e) conversation and discussion, (f) value beyond school. Their responses are summarized regarding each of the AIW criteria as follows:

- **Construction of Knowledge:** Expert Reviewer 1 suggested revising the Formative Performance Tasks so that they could form a single story map journal, helping students to construct their knowledge by connecting information from one task to the next. Expert Reviewer 2 suggested revising activities to allow students to discover the population growth topic over different geographic scales, instead of solely at a country level, to help them construct spatial knowledge.
- **Deep Knowledge:** Both Expert Reviewers suggested creating a Materials Box containing essential worksheets, instructions, and answer models to help facilitate deep knowledge for both teacher and student. Each reviewer also suggested ways to enhance the model's ability to improve a student's deep knowledge regarding the

population growth topic. Expert Reviewer 1 indicated that students must also learn about countries with negative and zero population growth, as well as the economic aspects of population growth. He also suggested adding text for teachers which described an ideal physical classroom environment for implementing the model. Expert Reviewer 2 noted that students need to discover the human development concept and how it relates to the population growth topic. He also strongly suggested revising the introductory activity so that it both introduces students to GIS technology and to the unit's key concepts.

- **Critical Thinking Skills:** Expert Reviewer 2 indicated that some of the model's GIS activities needed revising to involve students more deeply with the technology. He noted that GIS provides many opportunities for encouraging students to think critically, such as map creation, analysis, and spatial representation tools (e.g. Symbology).
- **Discussion and Conversation:** Expert Reviewer 1 suggested adding a feedback review activity to engage students in discussion. He also suggested revising one of the performance tasks to become a discussion-based activity.
- **Elaborated Communication:** Expert Reviewer 1 suggested adding a peer review activity to support communication between students. Expert Reviewer 2 advised taking advantage of GIS tools, such as the GeoForm app, for similar reasons.
- **Value Beyond School:** Both reviewers indicated that the model met this criterion sufficiently, and required no modifications to improve its performance in this area.

The reviewers also made other suggestions beyond simply improving AIW criteria performance. They each addressed the model from their own perspective, based upon decades of professional experience and knowledge. For example, Expert Reviewer 1 focused upon the IDM format and activities, as that is his speciality, while Expert Reviewer 2 addressed GIS activities and techniques more closely. These differences in Reviewer focus added value to the process of improving the model; the combination of their advice made the model stronger as a result.

Following Expert Reviewer advice and comments, four materials were added to the model: (1) a Materials Box (featuring worksheets, instructions, and model answers), (2) Procedures for Implementation, (3) A description of the classroom's recommended physical environment, and (4) Peer Evaluation activities. Additionally, 11 activities were revised following previous comments to increase the model's ability to facilitate AIW. As a result of these improvements, a ready-to-implement teaching model, with all necessary teaching materials and instructions, was developed for Kuwaiti social studies classrooms. This model is designed to enable Kuwaiti social studies teachers to better understand how to integrate GIS into their classrooms to support AIW.

While comments and advice from the US Expert Reviewers provided valuable feedback for improving the model, their cultural environments and/or educational policies are obviously different to those existing in Kuwait, which may have biased impressions of the model's effectiveness in this nation. To address this challenge, the researcher conducted a usability evaluation phase to identify potential barriers to the model's successful incorporation in a Kuwaiti school context, and to recommend suggestions for overcoming these obstacles. The usability evaluation process sought to answer the second question of the study: *What barriers exist for integrating this GIS Instructional Model into Kuwaiti social studies classrooms, and can anything be done to remove these obstacles?* To answer this question, the researcher sent the now-revised GIS Instructional Model to six Kuwaiti Expert Reviewers to record their impressions. The Kuwaiti experts also identified potential methods for overcoming these barriers. In this phase, the Expert Reviewers completed a written survey to provide their views and suggestions regarding the following four model implementation obstacles: (a) instructional and preparation time; (b) information technology infrastructure; (c) teacher preparedness; and (d) curriculum structure and policy.

Feedback from Kuwaiti experts revealed that there are a few challenges which require consideration before attempting to implement the model. The reviewers were concerned that a teacher's limited available time (both for them to learn the technology involved and to absorb the model within their curriculum) may impede model implementation. They remarked that a lack of suitable IT infrastructure, such as limited access to the necessary technological devices, internet and wi-fi in some schools, may also hinder implementation. They further noted that the social studies curriculum in Kuwait is highly standardized and provides limited opportunity to include GIS in classroom practices. They also found that most social studies teachers are not familiar with GIS; unsurprisingly, they also reported that pre-service and in-service teacher training programs do not prepare them to work with the technology.

The Kuwaiti Expert Reviewers countered these obstacles by offering some potential mitigation techniques. For example, despite Kuwaiti Expert Reviewers reporting instructional time restrictions, they did note that the model had flexibility and that it would be possible to revise its timeline, or reduce activity workloads, so that it could fit available teaching time. Regarding the potential lack of IT infrastructure, some experts suggested using a school's computer lab for the classroom to ensure that each student had access to GIS-enabled devices, or even to ask students to use their own smart phones, tablets or laptops for the class. With respect to teacher preparedness, two Expert Reviewers believed that the model would be easy to implement, while the other four suggested providing short GIS training courses/workshops to bring in-service teachers up to speed with the technology. In terms of curriculum structure and policy, two Expert Reviewers thought that the Kuwaiti curriculum would encourage teachers to integrate GIS into their classrooms. However, other reviewers recommended increasing educational stakeholder awareness about the potential benefits of GIS.

Based upon Kuwaiti Expert Reviewer feedback, it became clear that an execution plan was required to overcome model implementation obstacles. In the future, the researcher need to create a strategy, incorporating Expert Reviewer suggestions, as outlined below:

- **Instructional time:** Create more timeline options - reduce the scope of some activities; mark some activities as being optional; select some activities which a teacher can assign for homework instead of classwork.
- **IT infrastructure:** There are options for overcoming these obstacles. For instance, if insufficient computing devices are available for each individual student to use, teachers could reduce the number required by asking their pupils to work in groups. Alternatively, teachers could use their school's computer lab for their classroom space. And as a last resort, teachers could ask students to use their own smart phone, tablet or laptop.
- **Teacher preparedness:** While the model does have step-by-step instructions to help facilitate its implementation, the researcher may work with a school district to provide a short course or workshop for social studies teachers. These training sessions would help teachers gain the essential knowledge and skills they would need to implement the model, but also raise their awareness of the powerful benefits GIS can offer social studies instruction. Alternatively, each school could assign one teacher to

learn how to use the model, and they could then provide a workshop of their own to train colleagues.

- **Curriculum structure and policy:** As Kuwaiti national standards encourage teachers to apply technology in their classrooms, this model could provide a useful opportunity for GIS integration. In order to increase GIS awareness, the researcher could provide a one-day workshop to shed light on the technology's potential classroom benefits.

For its future implementation in Kuwait, the model will obviously need translating from its current English language format into Arabic. The researcher will also attach an implementation plan that has some suggestions for overcoming specific problems related to limited available instructional time, a lack of teacher preparedness, insufficient IT infrastructure, and curriculum structure/policy barriers. And finally, while the GIS Instructional Model will be applicable for some schools and teachers, others may not be sufficiently equipped for its implementation, making it inappropriate for them to use until their state of preparedness improves.

Limitations of the Study

There are two main limitations to the study. Firstly, as GIS is not currently included in Kuwaiti social studies curricula, and poorly applied in other school disciplines, it was difficult to find Kuwaiti experts to interview and achieve a comprehensive formative evaluation of the GIS Instructional Model. To address this challenge, the researcher depended upon the experience of American experts. US experts provided valuable feedback for improving the model, but the different working environments and/or educational policies that they have to operate within may bias these data regarding the model's effectiveness in Kuwait. To address this challenge, the researcher sent the final version of the GIS Instructional Model, along with a usability evaluation survey, to reviewers in Kuwait. Their observations helped to identify potential barriers against the model's successful incorporation in a Kuwaiti school context, and possible methods for overcoming these issues.

Secondly, despite the researcher striving to ensure that any Kuwaiti high school could adapt the final GIS Instructional Model to serve in their social studies classes, some schools will likely have insufficient IT infrastructure for model implementation, making it inappropriate for them to try doing so at this juncture. Recommendations to address this issue are discussed later in this chapter.

Contributions of the Study

There are many research studies which report upon the potential instructional benefits that GIS technology can offer regarding improved student knowledge and skills, especially regarding social studies content (Barstow, 1994; Baker & White, 2003; Kinniburgh, 2012; Huynh Sharpe, Charman, Tong & Greensmith, 2012), but very few schools have adopted it so far (Hong & Melville, 2018; Keiper, 1999; Kerski, 2003; Lam et al., 2009; Millsaps & Harrington 2017). The reason for this situation, as Kerski (2003) explained, is the absence of instructional models which demonstrate how to incorporate GIS into social studies curricula. He indicated that many social studies teachers lack knowledge about GIS technology, and have no clear idea for how to integrate it into their instruction practices. Thus, this study's main contribution is its attempt to address this problem by creating a theoretically-grounded, GIS Instructional Model that explains how to integrate GIS into classroom practices to improve student AIW through their performing GIS-based inquiry. The model provides ready-to-implement teaching lessons and lays out a clear example for how to use GIS in social studies instruction to support AIW. Social studies teachers should be more than able to use these lessons in their future practice, because they come complete with all materials and sources. In that sense, the model is a product, rather than a process or descriptive, and this is perhaps the model's greatest value.

Moreover, while there are a number of theoretically-based studies related to IDM or the AIW framework (Swan et al., 2015; Friedman, 2006; King, Newman and Carmichael, 2009), relatively few actually connect theory with its practical application. For example, Grant et al., (2017) noted that despite many researchers having reported the importance of inquiry, very few empirical studies have actually addressed the *performing* of inquiry in social studies classrooms. Another contribution this study makes, therefore, is closing the gap between research and practice. As already noted, this study aligned the principles of IDM and AIW criteria with the GIS activities planning process. It provides a practical example for how GIS could be used to perform inquiry to facilitate AIW in social studies classrooms. This model will help teachers to gain the knowledge they need for how they can connect educational theories, such as IDM and AIW criteria, with their technologically-driven practice or application.

Another contribution this study makes is that it introduces GIS technology to the Kuwaiti social studies classroom context. Largely due to the researcher's background, this study focused upon the use of GIS in social studies classrooms within the Kuwaiti educational system. This is essentially breaking new ground, as GIS is still not widely used for this purpose in Kuwait. Therefore, this research project helped to introduce the benefits of GIS technology in support of Kuwaiti social studies teaching practices. It is anticipated that the implementation of this model will help both teachers and students gain basic knowledge and skills for GIS. For example, teachers and students will be able to use a variety of GIS tools, such as Symbology, GIS analysis, configure-popup, and create GIS Layer, to both determine population growth characteristics and analyze their causes and consequences. As already intimated, these GIS activities will provide social studies teachers and students with the essential background and skills to work with GIS. Teachers could easily use these same activities and tools to cover other social studies topics.

Finally, this study also adds to the body of knowledge on the methodology of developmental research, serving as a model for using the developmental research approach for advancing the discipline's instructional practices. The five phases in the development of the GIS Instructional Model were described, and the model's validation, through formative feedback, was explained. Thus, this study can serve as a model for how design and development methodology might be employed in social studies education research.

Recommendations and Future Directions

This section presents recommendations to address some of the challenges or gaps in the present study. It also describes potential directions for future research and practice.

Recommendations for Future Research

In consideration of the study's findings, recommendations for future research emerged. The first recommendation involves employing additional expert reviewers. These reviewers may have experience and/or knowledge in the field for employing GIS, IDM and AIW within the social studies discipline. This further review would likely strengthen the model's quality by including the multiple perspectives and knowledge of these additional reviewers; the broadened diversity of ideas ensuring the model is more keenly refined to offer greater potential for meeting school and student needs.

The second recommendation involves pilot-testing the model in actual social studies classrooms to measure its implementation. This real-world evaluation would yield answers to help determine the model's effectiveness and what further revisions may be needed. To ensure the GIS Instructional Model is robust enough for implementing in different settings, this effort should take place across multiple schools.

Future researchers could focus upon improving teacher knowledge and skills regarding GIS. This could involve designing a geospatial course or a short training course for in-service social studies teachers in Kuwait. They could take advantage of lessons already learned by other countries' efforts towards integrating GIS, and collaborate with experts from these nations to validate training courses as ready-to-implement. These courses could help both in-service and pre-service teachers to understand the potential benefits of GIS, not to mention provide them with practical experience for using the technology in a classroom context.

The fourth recommendation involves studying Kuwaiti social studies teacher perceptions about GIS. It is important to understand their thoughts and ideas about the integration of GIS in social studies curriculum. This will help identify weaknesses and work to remove negative impressions, thereby helping to shape their future behavior and teaching practice. Indeed, teacher attitudes and beliefs are important factors towards the successful integration of GIS into classrooms, since teachers who have positive attitudes towards the technology are more likely to employ it in their instruction practices. Therefore, focusing on brightening teacher perceptions, attitudes, and beliefs regarding GIS will likely facilitate the technology's integration into the classroom.

Results from the above-mentioned future research suggestions would undoubtedly help update and enhance model performance, thus improving its effectiveness in the social studies classroom.

Recommendations for Future Practice

There are four recommendations for future practice. Firstly, there is a need to increase understanding amongst Kuwaiti educational policy makers and administrators for the potential that GIS technology holds, especially for the way that it can develop student skills and broaden their knowledge. Educational policy makers need clear evidence that shows how and why GIS technology makes a positive difference in student learning. The recommendations for future research, noted earlier in this chapter, could help build this evidence. For instance, pilot-testing the model to measure student-learning would likely show the capabilities and potential benefits of GIS for improving student-learning and skills; something which would surely resonate with policy makers. If this awareness were to arise, it would be much easier to integrate GIS into Kuwaiti secondary schools. Indeed, GIS would be more readily accepted once its potential benefits became known properly to all educational policy makers and stakeholders, especially those involved in curriculum design and development.

Secondly, social studies teachers must gain understanding for GIS, and possess at least a basic skill set for its application, before they will be able to implement this model. The educational system could promote this by providing professional development training in GIS technology for pre-service and in-service teachers. For pre-service teachers, teacher preparation universities could take an active role in facilitating the integration of GIS in secondary schools. For example, these universities could integrate GIS into their teacher education courses enabling them to use the technology in their future classrooms. For in-service teachers, a partnership between school districts and the higher education spatial technology industry (e.g. companies such as ESRI) would be helpful in providing a short training course or workshop that both informs active social studies teachers on the benefits of GIS and prepares them for implementing a GIS-based instructional model in their classroom practice.

The third recommendation concerns bringing schools up to a standard where they are properly prepared to implement a GIS-based Instructional Model. Using ArcGIS Online would overcome the software installation challenge, but there are still a few additional hardware issues to resolve. Some schools are still technologically behind, so there is a need to minimize these infrastructure barriers, e.g. providing schools with the necessary resources for using GIS, such as compatible computers/tablets, high speed internet and Wi-Fi, etc.

GIS is not widely used in Kuwait at present, nor is it included in Kuwaiti secondary school curriculum standards. Therefore, there is a need to include GIS in national standards to facilitate the integration of this technology into social studies classrooms and elsewhere. This would result in Kuwaiti social studies teachers being required (and trained) to teach using GIS, so implementing an instructional model, such as the one in this study, would be relatively easy. Moreover, school systems also need to de-emphasize the importance of standardized testing upon a student’s overall grade and should instead give more weight to student projects and other such work. Indeed, standardized testing tends to come with the negative side-effect of pushing teachers to focus students more on memory recall than their creation of Authentic Intellectual Work. Therefore, making space in the curriculum for student projects, such as those in the GIS Instructional Model, would lead to greater production of student AIW, and potentially broader academic success.

Researcher Future Practice

The researcher will work as an assistant professor in the College of Education at Kuwait University. The researcher's future job will focus upon preparing pre-service social studies teachers for their future careers. Thus, the future practice for the researcher focuses upon achieving three major goals related to this study's results.

Firstly, when I lead a social studies teaching methods class, I will endeavor to integrate GIS into its curriculum. I will inform pre-service teachers about the potential benefits GIS offers, and how they can integrate GIS into their classrooms. Moreover, in the field work class, I will ask my students (pre-service teachers) to implement GIS in their classroom; recording their impressions about this experience. This will both help pre-service teachers gain the basic knowledge, skills and confidence they will need for using GIS in their future careers, but also help me to improve my GIS instruction curriculum.

My second goal will focus upon providing GIS training courses and workshops for in-service teachers. The College of Education at Kuwait University offers many short training courses, workshops, and conferences for in-service teachers in Kuwait. I will design a short training course to help in-service social studies teachers integrate GIS into their classrooms. I also plan on initiating a conference to feature the importance of GIS in education, reviewing some successful examples from around the world. I hope to include global experts in the field at this conference, so they can shed light on the benefits of integrating GIS into the classroom. This will help to increase awareness amongst educational stakeholders and policymakers about the ways GIS can contribute to improved student learning.

I also hope to work on Kuwaiti curriculum standards reform. Kuwait University's College of Education regularly collaborates with the Ministry of Education regarding the nation's curriculum framework and standards, and my future aim is to participate on the curriculum development committee to improve the social studies curriculum. As I hope I have made clear, GIS should be included as a component of the national social studies curriculum, and

I will focus on making it so. In this way, GIS could easily be integrated into the nation's social studies classrooms.

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APPENDIX A

IRB REVIEW DECISION

VIRGINIA TECH.

Office of Research Compliance
Institutional Review Board
North End Center, Suite 4120
300 Turner Street NW
Blacksburg, Virginia 24061
540/231-3732 Fax 540/231-0959
email irb@vt.edu
website http://www.irb.vt.edu

MEMORANDUM

DATE:	November 5, 2018
TO:	David Hicks, Huda Salem Alazmi
FROM:	Virginia Tech Institutional Review Board (FWA00000572, expires January 29, 2021)
PROTOCOL TITLE:	Designing GIS Instructional Model to Facilitate Authentic Intellectual Work in Secondary Social Studies Classrooms in Kuwait: A Developmental Study
IRB NUMBER:	**18-929**

Based on the submitted project description and items listed in the Special Instructions section found on Page 2, the Virginia Tech IRB has determined that the proposed activity is not research involving human subjects as defined by DHHS and FDA regulations.

Further IRB review and approval by the Virginia Tech IRB is not required because this is not human research. This determination applies only to the activities described in the submitted project description and does not apply should any changes be made. If changes are made you must immediately submit an Amendment to the IRB for a new determination. Your amendment must include a description of the changes and you must upload all revised documents. At that time, the IRB will review the submission activities to confirm the original "Not Human Subjects Research" decision or to advise if a new application must be made.

If there are additional undisclosed components that you feel merit a change in this initial determination, please contact our office for a consultation.

Please be aware that receiving a "Not Human Subjects Research" Determination is not the same as IRB review and approval of the activity. You are NOT to use IRB consent forms or templates for these activities. If you have any questions, please contact the Virginia Tech IRB office at 540-231-3732 or irb@vt.edu.

PROTOCOL INFORMATION:

Approved As:	**Not Human Subjects Research**
Protocol Approval Date:	**November 5, 2018**

FEDERALLY FUNDED RESEARCH REQUIREMENTS:

Per federal regulations, 45 CFR 46.103(f), the IRB is required to compare all federally funded grant proposals/work statements to the IRB protocol(s) which cover the human research activities included in the proposal / work statement before funds are released. Note that this requirement does not apply to Exempt and Interim IRB protocols, or grants for which VT is not the primary awardee.

The table on the following page indicates whether grant proposals are related to this IRB protocol, and which of the listed proposals, if any, have been compared to this IRB protocol, if required.

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APPENDIX B

GIS INSTRUCTIONAL MODEL ONLINE SURVEY

GIS Instruction Model Evaluation Protocol

The purpose of this evaluation is to determine how well the GIS model supports the creation of Authentic Intellectual Work in social studies classrooms. Feedback on this model will be used to determine the quality of activities supporting students' authentic work, and to identify where additional development is required to improve it. As such, you will be asked to conduct a review of the "population growth and distribution" instructional lessons and to fill out the "evaluation rubric" and open-ended questions, which will then help me to improve this model.

Evaluation Rubric

The rubric focuses on two main questions:

- Inquiry: Is the model's compelling or guiding question adequately assisted by activities, sources, and supporting questions?
- Pedagogical application: Do the model's activities support students' authentic work such as 'construction of knowledge', 'communication skills', and 'critical thinking'?

Scoring Guide

The GIS Instruction Model Supports AIW (Low)
The unit's compelling or guiding question is minimally assisted by activities, sources and supporting questions. Additionally, the unit's activities only offer basic support of students' authentic work such as 'construction of knowledge', 'deep knowledge', 'substantive conversation', and 'communication skills'.

The GIS Instruction Model Supports AIW (Mid)
The unit's compelling or guiding question is adequately assisted by activities, sources and supporting questions. Additionally, the unit's activities sufficiently support students' authentic work such as 'construction of knowledge', 'deep knowledge', 'substantive conversation', and 'communication skills'.

The GIS Instruction Model Supports AIW (High)
The unit's compelling or guiding question is exceptionally well assisted by activities, sources and supporting questions. Additionally, the unit's activities offer exemplary support for students' authentic work such as 'construction of knowledge', 'deep knowledge', 'substantive conversation', and 'communication skills'.

The Model' Inquiry			
Compelling Question	**Low**	**Mid**	**High**
To what extent does the question provide students the opportunity to solve problems or explore an issue relevant to real-world life?	The question provides minimal opportunity to solve problems or explore an issue relevant to real-world life	The question provides sufficient opportunity to solve problems or explore an issue relevant to real-world life	The question provides ample opportunity to solve problems or explore an issue relevant to real-world life
Supporting Questions	**Low**	**Mid**	**High**
To what extent do the supporting questions' logic and sequence help students to construct knowledge?	The supporting questions' logic and sequence provide minimal help for students to construct knowledge.	The supporting questions' logic and sequence provide adequate help for students to construct knowledge.	The supporting questions' logic and sequence provide exemplary help for students to construct knowledge.

Pedagogical Application			
Construction of Knowledge	**Low**	**Mid**	**High**
To what extent do the unit's activities encourage students to think critically (such as to organize, interpret, analyze, synthesize, or evaluate information)?	The unit's activities provide only minimal opportunity to encourage students to think critically.	The unit's activities provide sufficient opportunity to encourage students to think critically.	The unit's activities provide ample opportunity to encourage students to think critically.
Deep Knowledge	**Low**	**Mid**	**High**
To what extent do the unit's activities support students in the construction of deep knowledge about population growth and distribution?	The unit's activities only basically support students in the construction of deep knowledge about population growth and distribution.	The unit's activities sufficiently support students in the construction of deep knowledge about population growth and distribution.	The unit's activities offer exemplary support for students in the construction of deep knowledge about population growth and distribution.

(Continued)

Pedagogical Application			
Substantive Conversation	**Low**	**Mid**	**High**
To what extent do the unit's activities encourage students to participate in discussions, arguments, and conversation?	The unit's activities minimally encourage students to participate in discussions, arguments, and conversation.	The unit's activities sufficiently encourage students to participate in discussions, arguments, and conversation.	The unit's activities offer exemplary encouragement for students to participate in discussions, arguments, and conversation.
Elaborated Communication	**Low**	**Mid**	**High**
To what extent do the unit's activities encourage students to communicate with others verbally or in writing?	The unit's activities minimally encourage students to communicate with others verbally or in writing.	The unit's activities sufficiently encourage students to communicate with others verbally or in writing.	The unit's activities offer exemplary encouragement for students to communicate with others verbally or in writing.
Value Beyond School	**Low**	**Mid**	**High**
To what extent do the unit's activities relate to real-world issues beyond the school walls?	The unit's activities minimally relate to real-world issues beyond the school walls.	The unit's activities sufficiently relate to real-world issues beyond the school walls.	The unit's activities relate exceptionally well to real-world issues beyond the school walls.

Open-Ended "World Population Growth " Model

- Do the model's activities encourage students to think critically, such as to analyze, compare, construct, and interpret information? Why or Why not?
- Do the model's activities support students in the construction of deep knowledge about population growth and distribution? Why or Why not?
- Do the model's activities encourage students to participate in discussions, arguments, and conversation? Why or Why not?
- Do the model's activities encourage students to communicate with others' verbally or in writing? Why or Why not?
- Do the model's activities relate to real-world issues 'beyond the school walls'? Why or Why not?

APPENDIX C

INFORMED CONSENT DOCUMENT

VIRGINIA POLYTECHNIC INSTITUTE AND STATE UNIVERSITY
Informed Consent for Participants in Research Projects Involving Human Subjects

Title of Project:
The Development of GIS Instructional Model to Facilitate Inquiry and Authentic Intellectual Work in Secondary Social Studies Classrooms in Kuwait

Principal Investigator:
Huda Salem Alazmi, Curriculum & Instruction, Virginia Polytechnic Institute and State University

I. Purpose of this Research/Project

The purpose of this study is to design the GIS instruction model. This design explores the potential for using GIS as an inquiry tool that fosters Authentic Intellectual Work objectives. The following research question guided the study: What is the best way to design a GIS model that focuses on (a) AIW in the form of geographic inquiries, (b) supporting students' critical thinking, problem solving, and decision making skills, and (c) facilitating collaborative learning through the inquiry arc?

II. Procedures

I will meet at a participant's office or another mutually agreed upon place to conduct an hour-long recorded interview. Due to research requirements, if a participant is unwilling to be recorded, then they are ineligible to participate. I will transcribe the audio recording of the interview. Within a few days, you will receive the transcript via e-mail. Please review the document, and let me know if you have any corrections, suggestions or additions to make. At the end of the interview you will be asked to complete a demographic questionnaire. These findings will be incorporated into a PhD dissertation which may be submitted for publication.

III. Risks

There are minimal risks to participate in this study.

IV. Benefits

There are no direct benefits for participation in this study. Additionally, no promise or guarantee of benefits has been made to encourage me to participate either. However, this study will provide you the chance to share your experiences in social studies education instruction, which will in turn help to design a GIS instruction model for social studies classrooms to facilitate students' authentic work. It will improve social studies teaching and learning by creating an effective instruction model. The researcher also believes that this study will create the chance for further research in this field to better improving social studies education in the future.

V. Extent of Anonymity and Confidentiality

Information gathered from the study may be used in research reports, presentations, and articles in professional journals. However, real names will not be used in research publications. A pseudonym will be used to protect your identity, if you wish. All interviews will be audio-recorded. Interviews will be transferred to password protected and/or encrypted files. All recordings and transcriptions will be destroyed once the study concludes. The Institutional Review Board (IRB) may view this study's collected data for auditing purposes. The IRB is responsible for supervising the protection of human subjects involved in research.

VI. Compensation

There is no compensation for participating in this study.

VII. Freedom to Withdraw

You are free to withdraw from this study at any time. You also have the right not to answer any question.

VIII. Participant's Responsibilities

I voluntarily agree to participate in this study. I have the following responsibilities: to participate in a one-on-one interview of no more than one hour, as described in Section II above. I am also responsible for reviewing the interview transcript, and submitting my responses to the researcher.

IX. Participant's Permission

I have read the Consent Form and conditions of this project. I have had all my questions answered. I hereby acknowledge the above, and give my voluntary consent:

____ Date__________

Participant signature

____

Printed Name of Participant

____ Date __________________

Signature of Principal Investigator

____

Printed Name

X: Questions or Concerns

Should you have any questions about this study, you may contact Huda Alazmi, Principal Investigator, ahuda1@vt.edu or Dr. David Hicks, Departmental Unit Chair, Hicks@vt.edu

APPENDIX D
INTERVIEW PROTOCOL

Welcome:

Hello, my name is Huda Alazmi, and I am conducting a study that will enable me develop a GIS instruction model that will facilitate authentic intellectual work in social studies classrooms. As the first step in my research, I would like to find out how I can improve this model by learning from your experiences and views.

Before moving on, be sure to:

- Remind the participant that answers are anonymous and confidential and will only be used in data analysis.
- Obtain the participant's signature on the informed consent form.
- Ask for permission to audiotape the interview.
- Define the GIS instructional model

Questions

1. If you were to implement this unit, what changes would you make to improve student critical thinking skills, and how would you accomplish them? **(Construction of knowledge Criteria)**
2. Do you have any other recommended changes or suggestions which would improve class activities to promote student acquisition of deep knowledge? If so, what would they be, how would you implement them, and in what activities should they be accomplished? **(Deep knowledge)**
3. Can you think of better strategies to foster communication and collaboration between students? If so, what would they be, how would you implement them, and in what unit activities would you recommend they take place? **(Communication)**
4. Are there any additional unit activities you could suggest that will allow multiple perspectives and points of view? If so, what would they be, and how and why should they be implemented? **(Substantive conversation)**
5. How would you improve this unit to connect it more closely to real-world issues or students' personal experiences, and if so, why? **(Value beyond school)**
6. Do you have any recommendations for increasing this unit's ability to improve student skills and knowledge?
7. Do you feel the unit is complete and provides enough detail in order for you to effectively implement it within the classroom? If so, why (or why not)?
8. Is there anything that needs to be added? If so, what?
9. Is there anything that needs to be changed? If so, what?

Closing:

- Be sure to thank the participant for their time.
- Repeat my contact information

APPENDIX E

USABILITY EVALUATION SURVEY

Usability Evaluation Protocol

Evaluation of feedback will be used to determine any potential barriers to the GIS unit's classroom employment, and to identify where additional development is required. As such, you will be asked to conduct a review of the "world population growth" lessons and to fill out the "evaluation usability rubric" and open-ended questions, which will help me to consider the barriers in the implementation phase. This evaluation seeks to investigate the following question "How easy will it be to integrate and use the GIS instruction model in Kuwaiti social studies classrooms?" Usability evaluation focuses on the level of difficulty for a teacher to employ the GIS instruction model in social studies classrooms. Factors to consider are the school's infrastructure, its teachers' available time and preparedness, as well as any potential curriculum barriers.

Scoring Guide

Usability to apply GIS instruction unit (Low)
The effort required to integrate GIS into social studies classrooms fails to meet expectations. Schools are minimally prepared to use GIS in classrooms. The teachers do not have knowledge or skills regarding how to employ GIS in their lessons. The curriculum is highly standardized, without space to use GIS in classrooms.

Usability to apply GIS instruction unit (Mid)
The effort required to integrate GIS into social studies classrooms meets expectations. Schools are adequately prepared to use GIS in classrooms. The teachers have the basic knowledge and skills required to employ GIS in their lessons. The curriculum is highly standardized, but there is an opportunity to use GIS in classrooms.

Usability to apply GIS instruction unit (High)
There is minimal effort required to integrate GIS into social studies classrooms. Schools are exemplarily prepared to use GIS in their classrooms. The teachers have sufficient knowledge and skills regarding how to use GIS in their lessons. The curriculum is flexible and encourages teachers to use GIS in classrooms.

Usability Evaluation Rubric			
Time	**Low**	**Mid**	**High**
How difficult will it be to employ this GIS instruction unit in social studies classrooms?	The time required to integrate GIS into classrooms is excessive, and fails to meet expectations.	The time required to integrate GIS into classrooms meets expectations.	The time required to integrate GIS into classrooms is minimal.
School Infrastructure	**Low**	**Mid**	**High**
To what extent are schools in Kuwait prepared to use GIS in the classroom?	The schools are marginally prepared to use GIS in their classrooms.	The schools are adequately prepared to use GIS in their classrooms.	The schools are exceptionally well prepared to use GIS in their classrooms.
Teacher Preparedness	**Low**	**Mid**	**High**
To what extent are social studies teachers able to use GIS in classrooms?	The teachers do not have the knowledge or skills to use GIS in their classrooms.	The teachers have adequate knowledge and skills to use GIS in their classrooms.	The teachers have excellent knowledge and skills to use GIS in their classrooms.
Curriculum Barriers	**Low**	**Mid**	**High**
To what extent does the social studies curriculum encourage the use of GIS in classrooms?	The curriculum is highly standardized and provides no opportunity to use GIS in classrooms.	The curriculum is highly standardized, but there is an opportunity to use GIS in classrooms.	The curriculum is flexible and provides the opportunity to use GIS in classrooms.

Open-Ended Questions

- Will the GIS instruction model be easy to use in social studies classrooms? Why or why not?
- Are the schools in Kuwait prepared to integrate GIS in their classrooms? Why or why not?
- Are the teachers able/prepared to use GIS in their classrooms? Why or why not
- Does the curriculum encourage teachers to use GIS in their classrooms? Why or why not?
- What your suggestions to overcome these barriers? How?

APPENDIX F

FINAL GIS INSTRUCTIONAL MODEL MATERIALS

This APPENDIX presents the supplementary materials of final GIS instructional model. Table F describes the materials that added on final GIS instructional model.

Table F

Materials of final GIS Instructional Model

APPENDIX F	Task	Materials
F1	Staging compelling question	(A) Screen shots of Map Journal (B) Story map graphic organizer
F2	Supporting question #1	(A) Step-by-Step Instructions & Questions (B) Map Journal Instructions & Rubric (C) Peer Review Instructions (D) Peer Evaluation Form (E) Model of Story Map journal
F3	Supporting question #2	(A) Step-by-Step Instructions & Questions (B) Map Journal Instructions & Rubric (C) Peer Review Instructions (D) Peer Evaluation Form (E) Model of Story Map Journal
F4	Supporting question #3	(A) Step-by-Step Instructions & Questions (B) Map Journal Instructions & Rubric (C) Peer Review Instructions (D) Peer Evaluation Form (E) Model of Story Map Journal
F5	Summative performance task	(A) Argumentative Essay Instructions (B) Argumentative Essay Evaluation Form (C) Model of Argumentative Essay
F6	Take informed action task	(A) Overview of GIS Project (B) Project based GIS: Step by Step Instructions (C) Presentation Instructions (D) Self and Peer Evaluation of GIS Group Project Form

APPENDIX F1

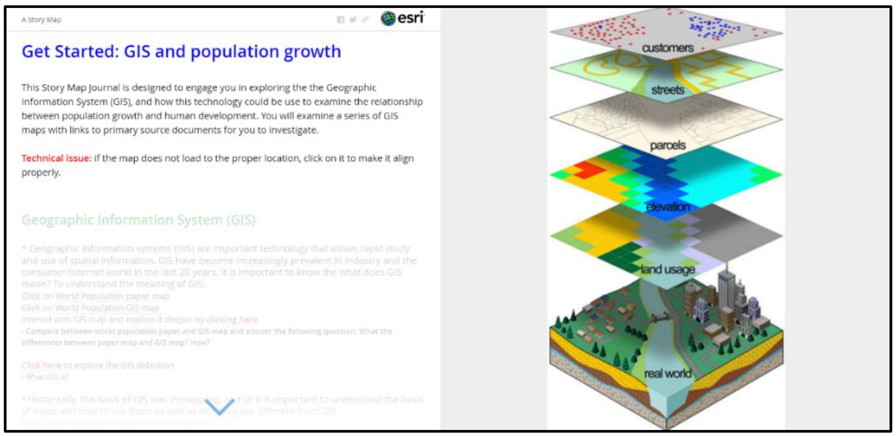
Staging Compelling Question Materials

<u>Material A:</u>

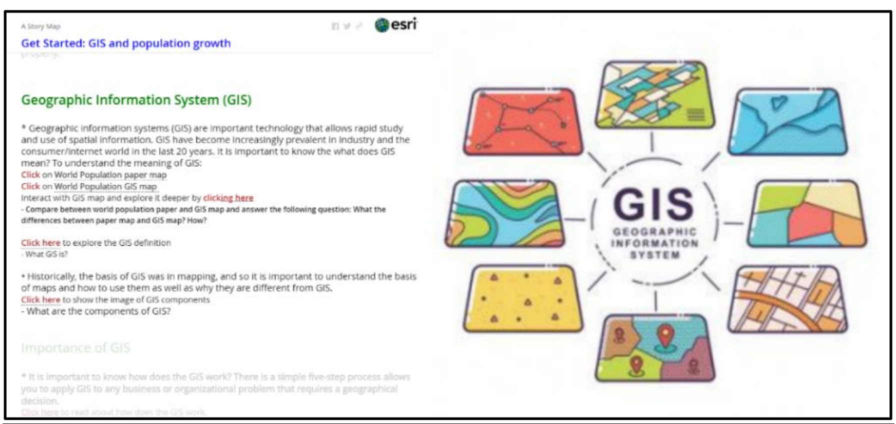
Story Map of Staging Compelling Question

Click on https://arcg.is/0GumvS OR see the screenshots of story map slides:

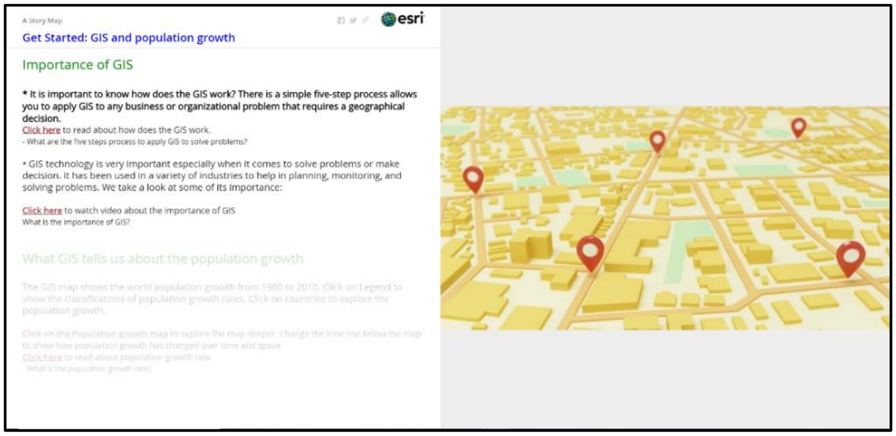
Slide 1:



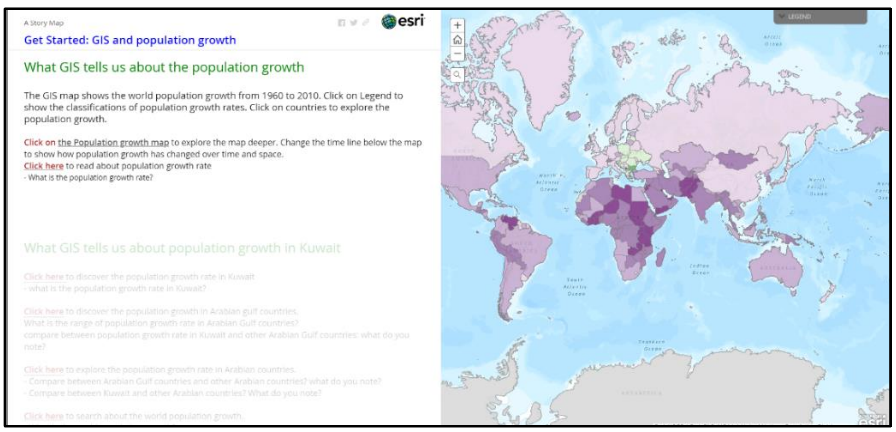
Slide 2:



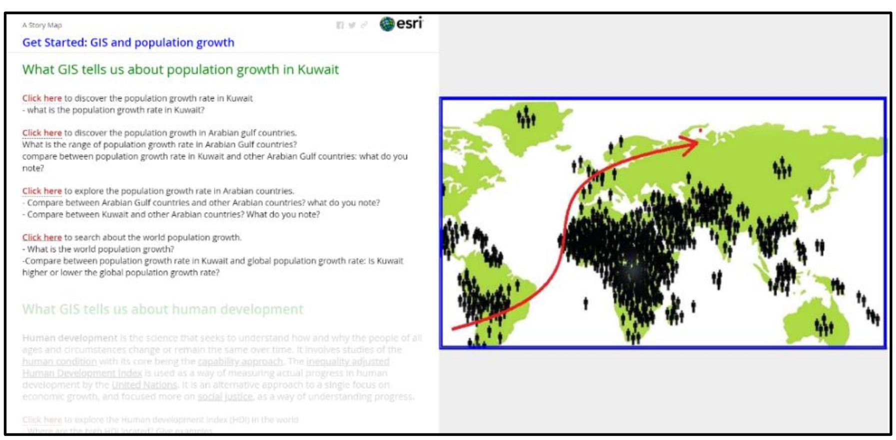
Slide 3:



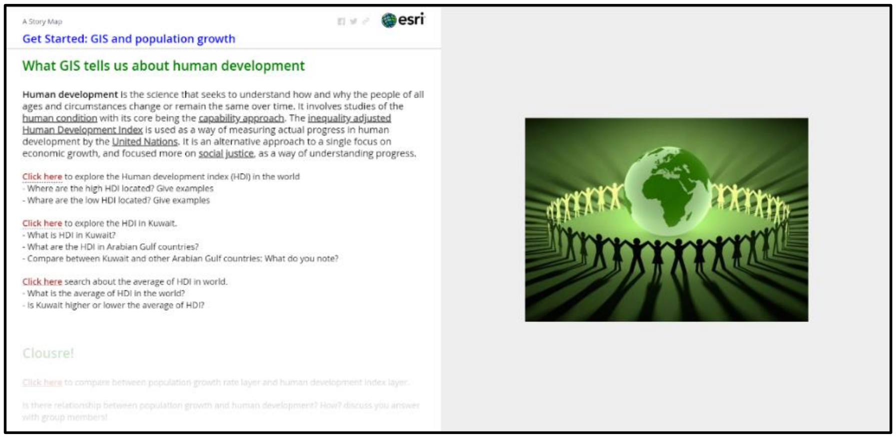
Slide 4:



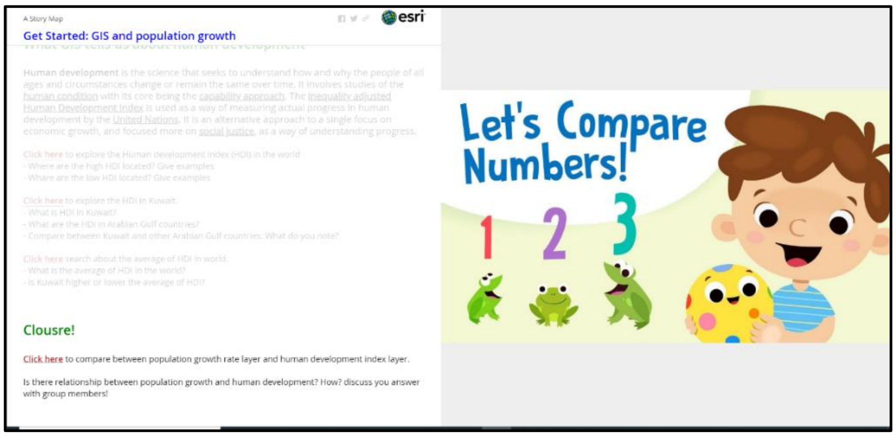
Slide 5:



Slide 6:



Slide 7:



Material B:

Story Map Graphic Organizer Worksheet

Intro to Compelling Question: "Is population growth good or bad for human development?"

Time Goal: 45 minutes

Story Map: https://arcg.is/0GumvS

Story Map Directions	Guiding Questions
Geographic Information System (GIS) Read a definition of GIS. Show image depicting GIS components? Compare a GIS world population map with its paper equivalent.	What is GIS? What are the components of GIS? What are the differences between a paper map and GIS map?
Importance of GIS Watch a video about the importance of GIS. Read about how GIS works.	What is the importance of GIS? What are the five steps needed in applying GIS to solve problems?
What GIS tells us about population growth Explore the GIS population growth map. Read about population growth.	What is the population growth rate?

<u>What GIS reveals about population growth in Kuwait</u> Investigate the population growth rate map in different scales: Kuwait, the Arabian Gulf, and Arabian countries. Compare population growth rates between Kuwait and other Arabian Gulf countries. Compare population growth rates for nations in the Arabian Gulf and those for other Arabian states. Investigate world population growth. Compare the Kuwaiti population growth rate to that of the globe.	What is Kuwait's population growth rate? What is the range of population growth rates across nations in the Arabian Gulf? What do you note? What do you note? What is the world population growth? Is Kuwait's population growth rate higher or lower than the globe's?
<u>What GIS tells us about human development</u> Explore the Human Development Index (HDI) in the world GIS map. Using the GIS map, explore the HDI across different scales: Kuwait and the Arabian Gulf. Compare HDI between Kuwait and other Arabian Gulf countries. Search for the global average HDI.	Where are areas of high HDI located? Examples? Where are areas of low HDI located? Examples? What is Kuwait's HDI? What are the HDI for Arabian Gulf countries? What do you note? What is the average global HDI? Is Kuwait's HDI higher or lower than the global average?
<u>Closure</u> Compare the GIS map population growth rate layer to the HDI layer.	Is there a relationship between population growth and human development? How so?

<u>Closure</u>: Is population growth good or bad for human development? Discuss with group mates.

APPENDIX F2

Supporting Question #1 Materials

Material A

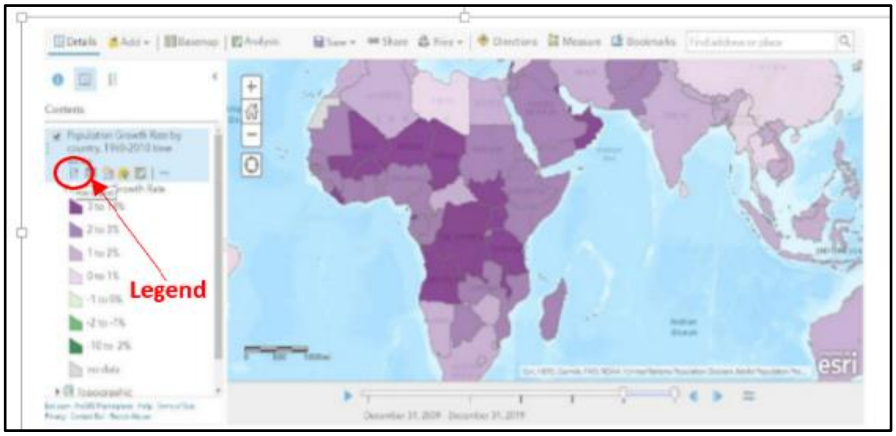
Step-by-Step Instructions & Questions

Activity 1

Ask: World Population View
Click **Add → Search for Layers**
Type: "World Population Growth"
Click **GO**
Add "World Population Growth from 1960-2010" map created by maps.com
On the ribbon, click on the Population Growth Rate Map, then Click **Show Contents**

Press on the timeline below the map to discover how the population growth rate has changed over time.

Click **Show Legend** under the population growth layer to show the growth rate groups for the countries.



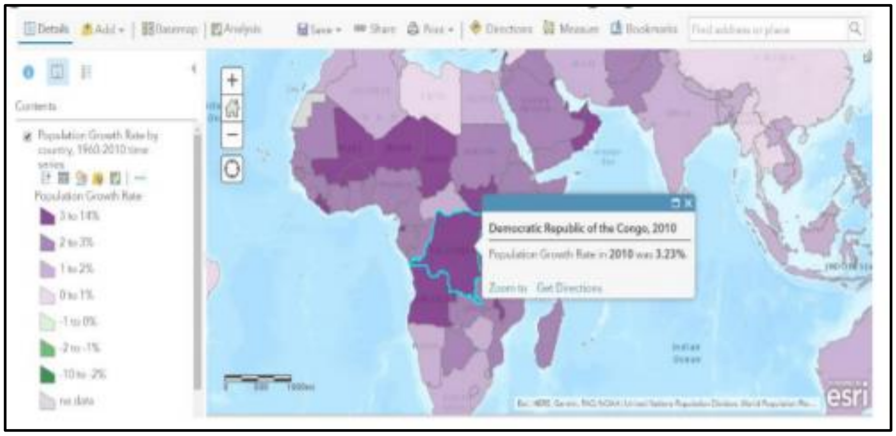
- What do you observe when you look at a world population growth map? Write down your ideas
- What questions do you have about the World Population Growth Map?

Activity 2

<u>Acquire: World Population Growth Characteristics</u>

Move the timeline under the map to 2010

Click on a country to show its details.



Show more details by clicking on the attribute table. The table shows the country names, region, population rate, and years.

Using the definitions below, classify the Population Growth data for 2010 as being either 'very high growth', 'high growth', 'low growth', or 'very low growth.'

Very low population growth 0-1%	Low population growth 1-2%	High population growth 2-3%	Very high population growth +3%

Activity 3

<u>Explore: Population growth over time</u>

Press on the timeline below the map to move between years.

Independently fill out the table below:

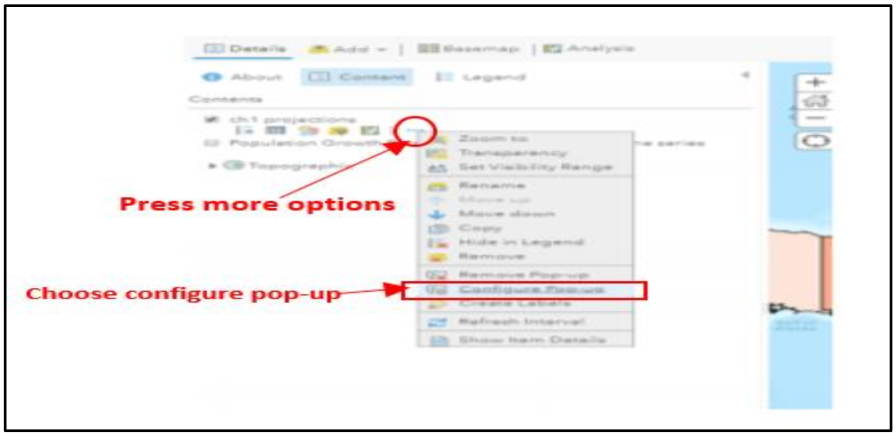
World Population Growth from 1960 to 2010

Country	1960s	1970s	1980s	1990s	2000s	2010
China						
India						
Afghanistan						
Germany						
USA						
Kuwait						
Nigeria						
Switzerland						

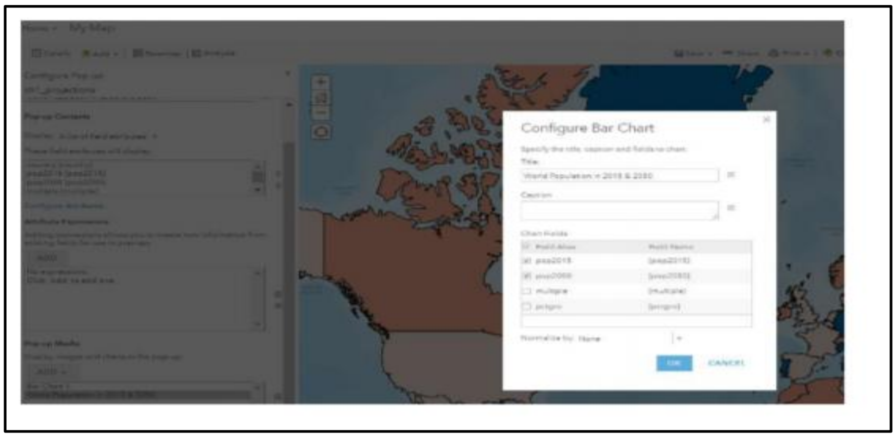
- Compare between world populations in 1960 and 2010. How has the world's population changed?
- Which countries experienced an increased population growth rate from 1960-2010?
- Which countries had a decreased population growth rate from 1960-2010?
- Which countries experienced only minor or no population growth rate changes from 1960-2010?

Activity 4

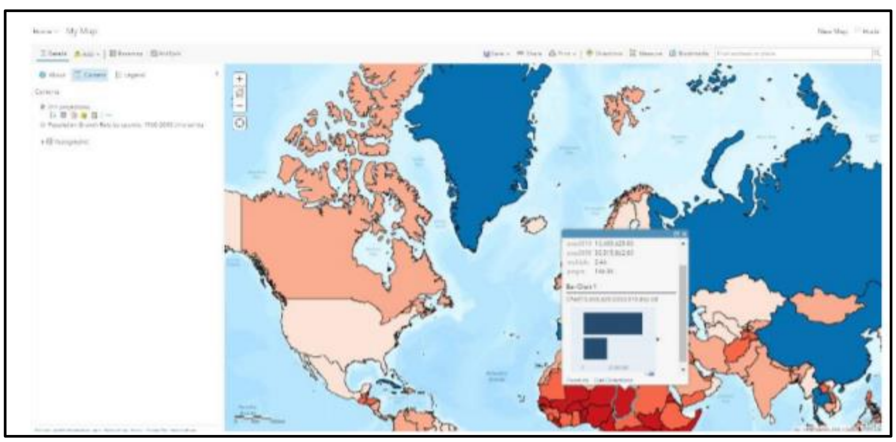
Analyze: Future Trends of World Population Growth
Click **Add → Search for Layers**
Type: "Global Population Changes in the 21st Century"
Click **GO**
Add a 'Global Population Changes in the 21st Century' layer; make sure the layer is checked 'on'.
In the content box for the world population growth layer click the 'more options' icon, and choose **configure pop-up**.



Move to **Pop-up media**→ **Add** bar chart→ write the title "World Population in 2015 & 2050" in the bar chart box → in **chart fields**, select 2015 and 2050→ click **OK**.



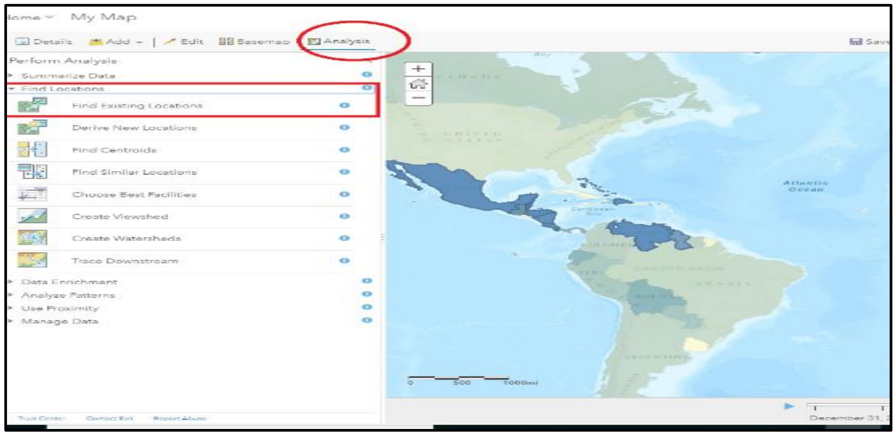
Click on countries to show details and bar chart.



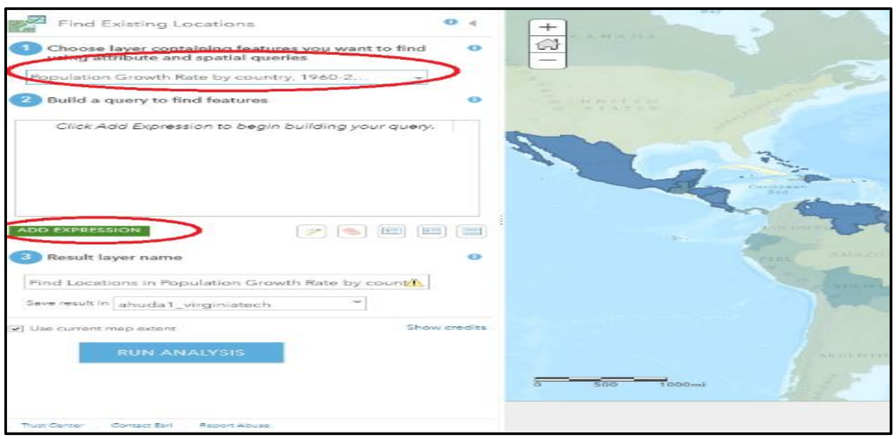
Complete the following questions:

- Compare populations for 2015 and 2050. How will the population change in the future?
- List the five most populated and five lowest populated countries predicted for 2050.

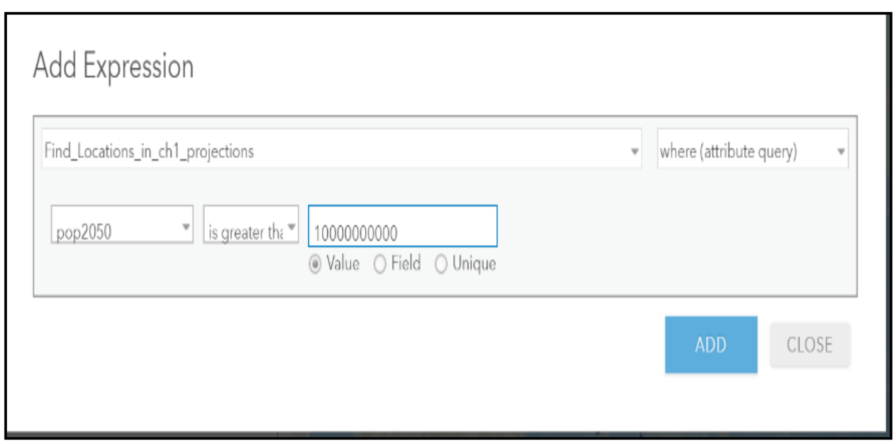
Click **Analysis**→ click **Find Location**→ choose **Find Existing Locations**



Choose the “Global Population in the 21st Century” layer→ then click **Add Expression**



In the first box, choose ‘pop2050’→ in second box choose ‘greater than’→ in the third box write “1,000,000,000” (1 billion) → click **Add**→ click **Run Analysis**



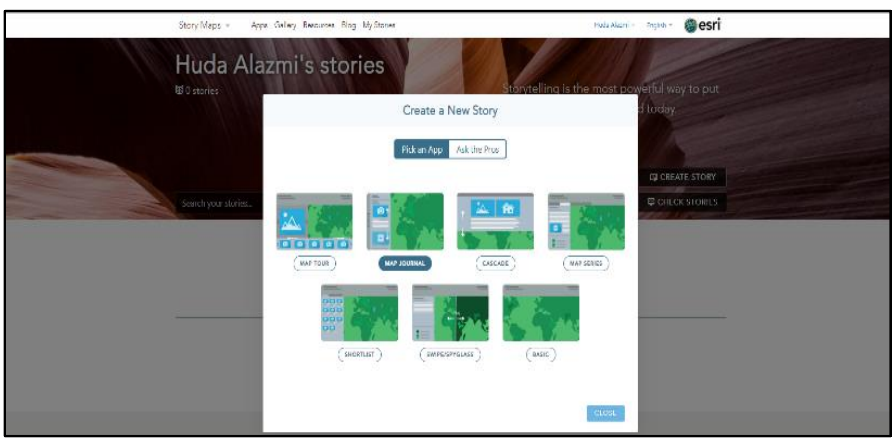
The new map shows the countries where the population is expected to be greater than 1,000,000,000 (1 billion) in 2050. Which countries are these, and on which continent are they located?

Activity 5

Act: Creating Journal Map

Go to http://storymaps.arcgis.com/en/my-stories/
Click C**reate Story**

Choose **Map Journal**



Enter the title for your map journal, and follow the instructions to begin its creation.

<u>Material B</u>

Map Journal Instructions & Rubric

Create a map journal showing how the world's population has changed over time? Support your map journal with data from your saved GIS maps, images, and numbers.

Your work must include the following:

- Write an introduction about the concept of population growth.
- List at least three examples of countries with population growth rates in each of the following four classifications 'very low', 'low', 'high', and 'very high'. Add a description for each entry.
- Explain how population growth has changed between of 1960 to 2010, and list examples.
- Describe future predictions for population growth, and list examples.

Consider the following notes:

- Work within your group.
- Use description text.
- Mention numbers and locations on the map.
- Using images and graphs, explain your ideas. You can Google for images or graphs.
- The following Rubric will be used to evaluate your work.

	Below Standard	Adequately Meets Standard	Exceeds Standard	Exemplary
Organization	Confusing, and many ideas and concepts are missing	Somewhat organized; contains a few ideas and concepts related to the supporting question.	Thoughtfully organized, and contains most of the ideas and concepts related to the supporting question.	Well organized, and contains all concepts and ideas related to the supporting question.
Use of color/ GIS maps/ images/ graphs	Students use little color and don't use images, GIS maps or graphs to illustrate connections with ideas.	Students use obvious color with images to illustrate some ideas.	Students use effective color with GIS maps and images to illustrate most of their ideas.	Students use multiple colors and include images, GIS maps, and graphs to illustrate each of their ideas.
Content	Bare minimum of content covered without evidence or examples	Shows basic ideas with a few examples and/or evidence	Shows a solid understanding for most content using examples and evidence	Shows a solid understanding for all content using examples and evidence

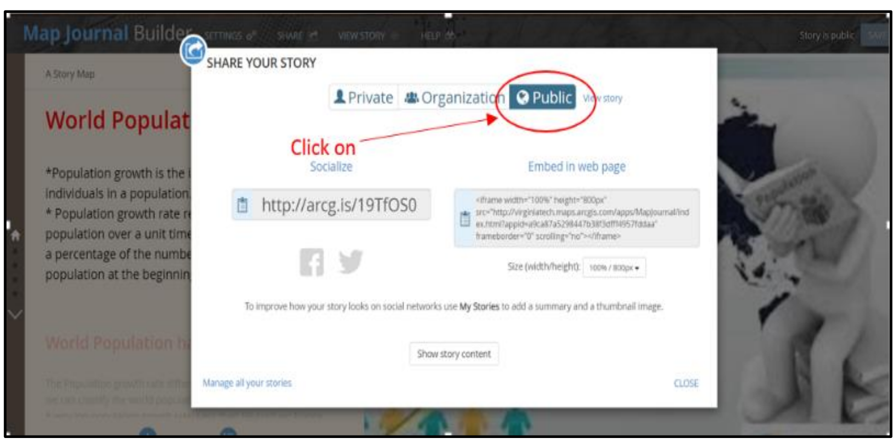
Material C

Peer Review Instructions

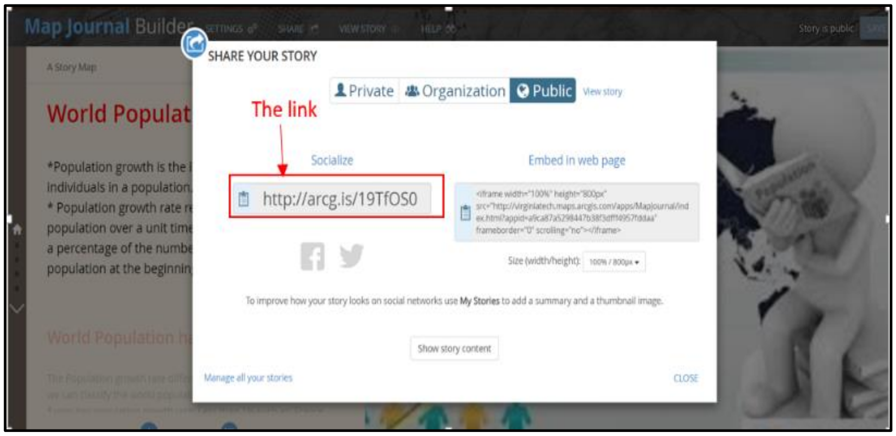
Now that a map journal is created, it is time to share your work with other groups to get their feedback for improving your journal. Follow the instructions below:

- Click the **Share** button near the top of the map journal.

- Click **Public**. Now anyone will be able to see or search for your map journal.



- Share your map journal with others by copying the link provided in the box.



- To receive their feedback, send your map journal link to the other groups. Each group will meet and take turns providing comments and advice to the other groups. Now fill out the peer evaluation form. After completing the feedback forms, each group will revise their map journal to reflect the notes they received from their classmates. Now send your updated map journal to your teacher so they can evaluate your work.

Material D

Peer Evaluation Form

Your names:
Pair names:

Please fill out this rubric honestly, being as accurate as you can. Be positive but direct when giving feedback. Point to specific examples in the map journal that need improvement. Give appropriate suggestions for the other group to improve their work. Please provide an explanation for the rubric score that you have given to your peers on the reverse side of this sheet.

Formative Performance Task 1 Map Journal Rubric

	Below Standard	Adequately Meets Standard	Exceeds Standard	Exemplary
Organization	Confusing, and many ideas and concepts are missing	Somewhat organized; contains a few ideas and concepts related to the supporting question.	Thoughtfully organized, and contains most of the ideas and concepts related to the supporting question.	Well organized, and contains all concepts and ideas related to the supporting question.

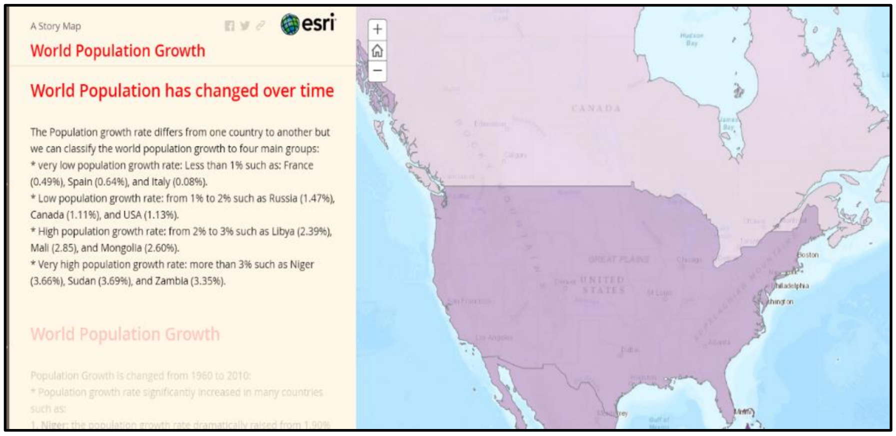
Use of color/ GIS maps/ images/ graphs	Students use little color and don't use images, GIS maps or graphs to illustrate connections with ideas.	Students use obvious color with images to illustrate some ideas.	Students use effective color with GIS maps and images to illustrate most of their ideas.	Students use multiple colors and include images, GIS maps, and graphs to illustrate each of their ideas.
Content	Bare minimum of content covered without evidence or examples	Shows basic ideas with a few examples and/or evidence	Shows a solid understanding for most content using examples and evidence	Shows a solid understanding for all content using examples and evidence

<u>Material E</u>

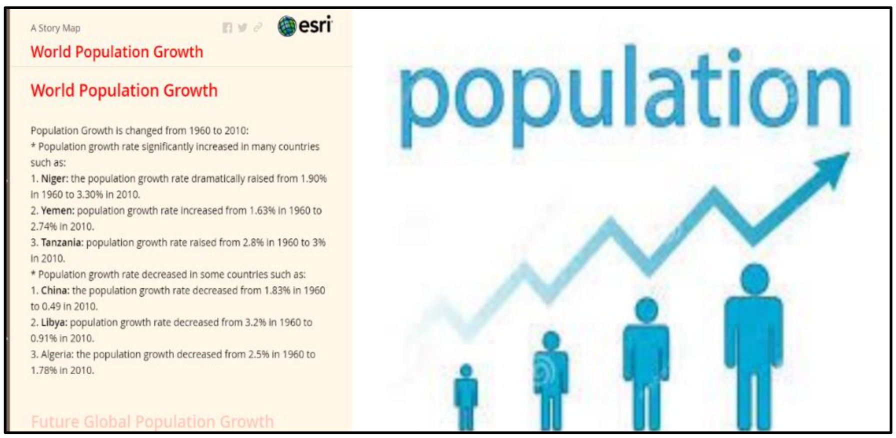
A Model of Supporting Question #1 Map Story Journal

Slide 1

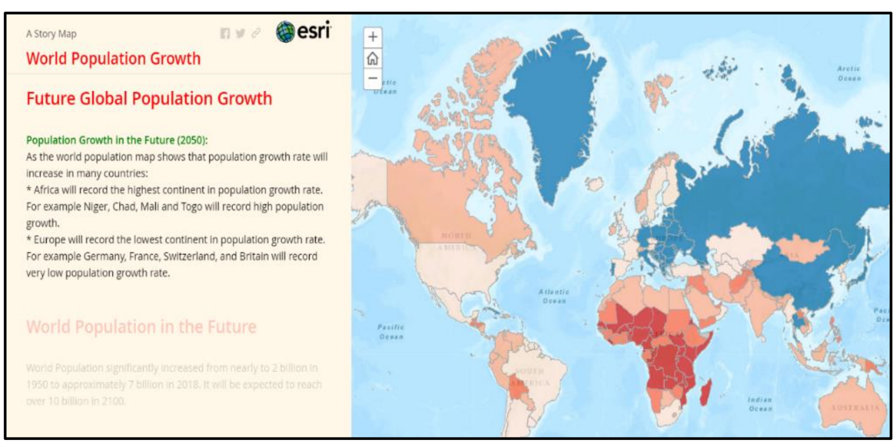
Slide 2



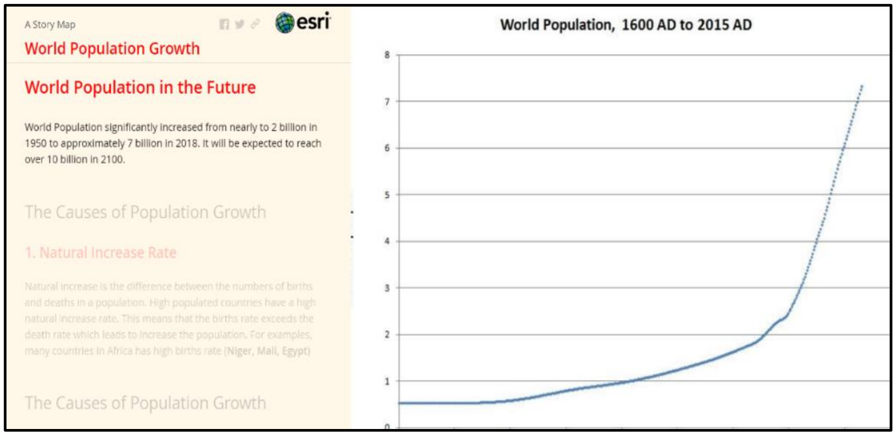
Slide 3



Slide 4



Slide 5


A Story Map
World Population Growth
World Population in the Future
World Population significantly increased from nearly to 2 billion in 1950 to approximately 7 billion in 2018. It will be expected to reach over 10 billion in 2100.
The Causes of Population Growth
1. Natural Increase Rate
Natural increase is the difference between the numbers of births and deaths in a population. High populated countries have a high natural increase rate. This means that the births rate exceeds the death rate which leads to increase the population. For examples, many countries in Africa has high births rate (Niger, Mali, Egypt)
The Causes of Population Growth
World Population, 1600 AD to 2015 AD
8
7
6
5
4
3
2
1
0

APPENDIX F3

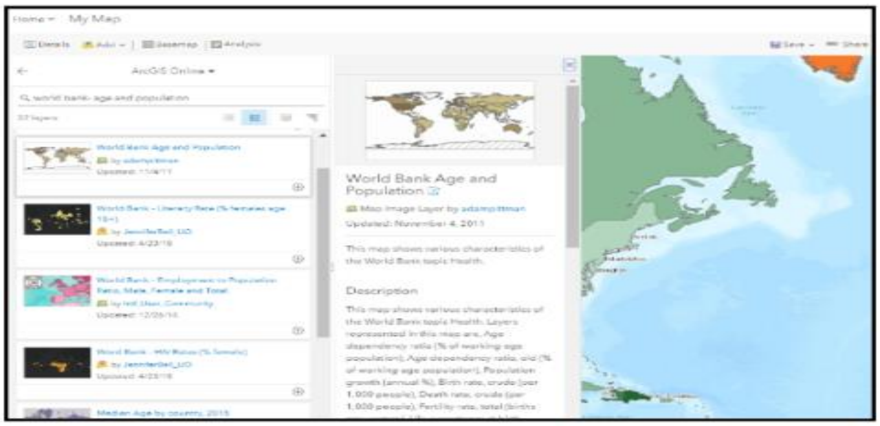
Supporting Question #2 Materials

<u>Material A</u>

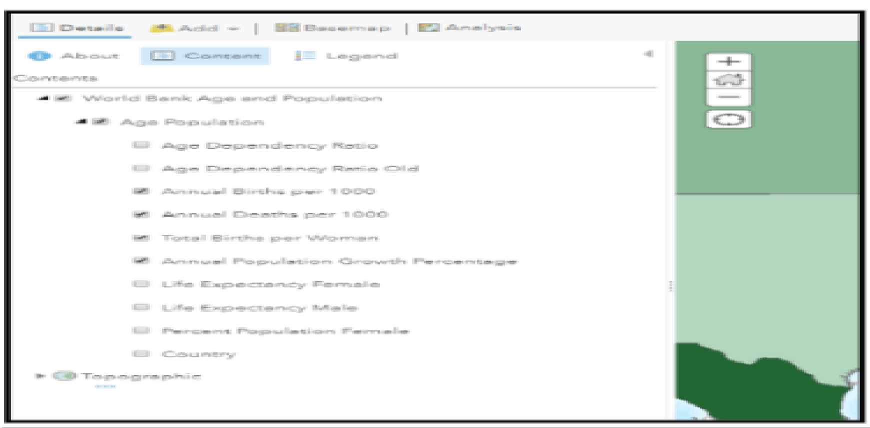
Step-by-Step Instructions & Questions

Activity 1

<u>Ask: Natural Increase Rate</u>
Click **Add**, in the search box. Write "World Bank-Age and Population", then select the map, and click **Add Map**.



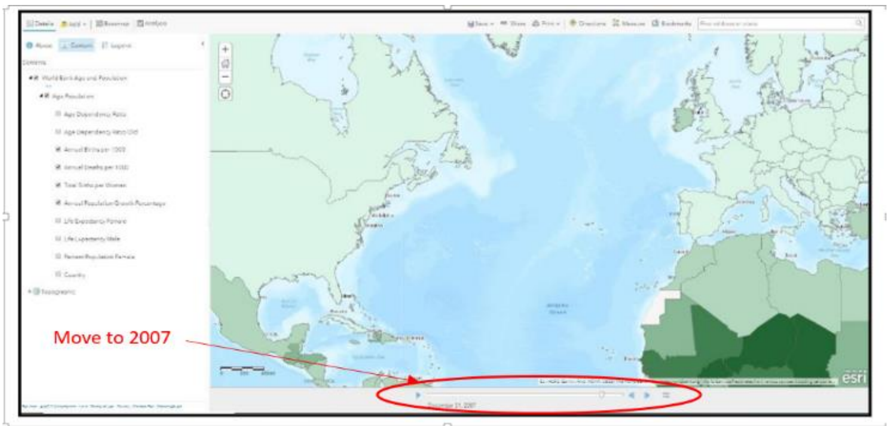
Turn off all map layers except "Annual Births per 1,000", "Annual Deaths per 1,000", "Births per Woman", and "Annual Population Growth".



Look at the map, and answer the following question: What questions do you have?

Activity 2

<u>Acquire: Basic Population Growth Concepts</u>
Click on the timeline under the map, and move to 2007.



On the ribbon, click **Show Legend** to see the rate classification, and fill out the following table:

Natural Increase, Life Expectancy, and Fertility Rate

Country	Annual Births per 1,000	Annual deaths per 1,000	Total Births per woman	Life Expectancy
Kuwait				
Arabian Gulf Countries • Saudi Arabia • Emirates • Qatar • Bahrain • Oman				

Arabian Countries (Look at all countries and write down 5 examples) - - - -				

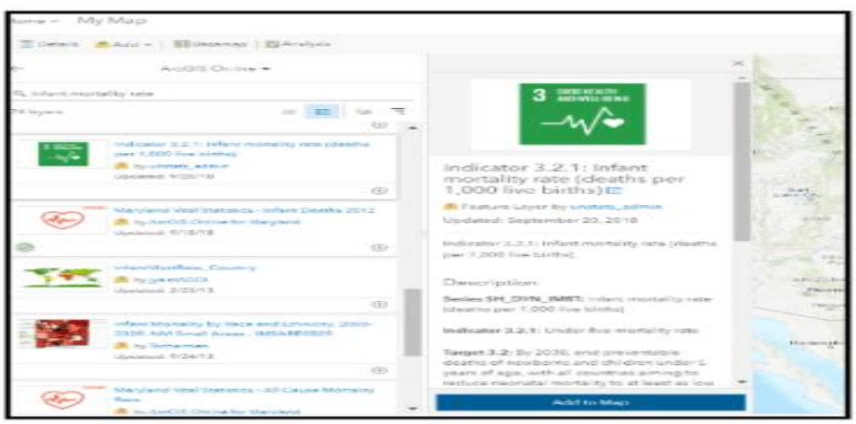
- Compare your country (Kuwait) with Arabian Gulf countries. What do you observe?
- Compare Kuwait with other Arabian countries, what do you observe?
- Compare between Arabian Gulf countries and other Arabian countries. What do you observe?
- Give examples of Arabian countries with high fertility rates and a low fertility rates.
- Give examples of Arabian countries with high life expectancy and low life expectancy.

Go to http://www.google.com and search for details about the world average life expectancy, and answer following question: Is Kuwaiti life expectancy higher or lower than the world average? Why? You can search in google.

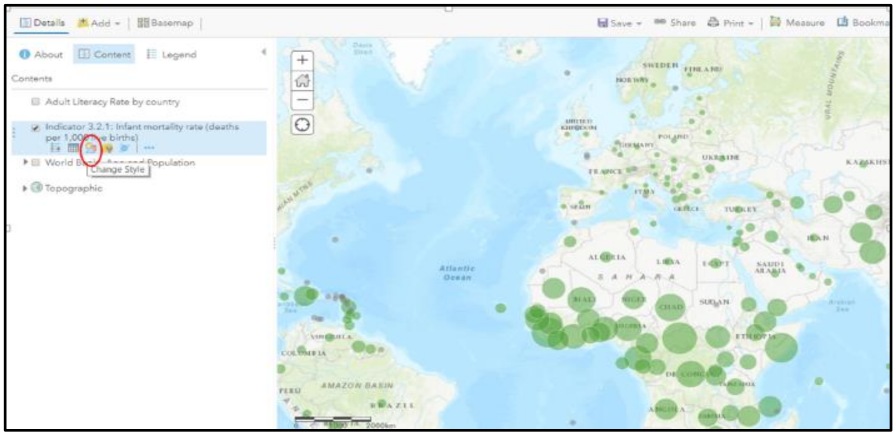
Go to http://www.google.com and search for details about the average world fertility rate, and answer following question: Is the Kuwaiti fertility rate higher or lower than the world average? Why? You can search in google.

Infant mortality Rate

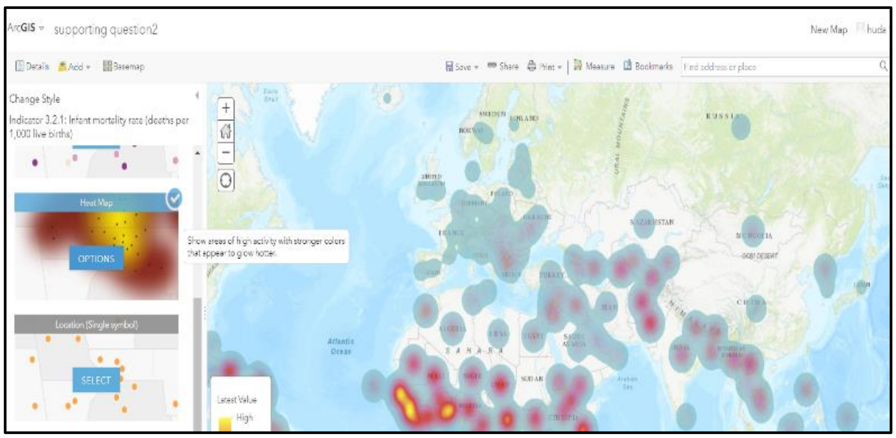
On the ribbon, click **Add**. Write "Infant Mortality Rate" in the search box, and click **Add Map**.



Click **Change Style** to change map Symbology



Select **Heat Map**, then click **Done**.

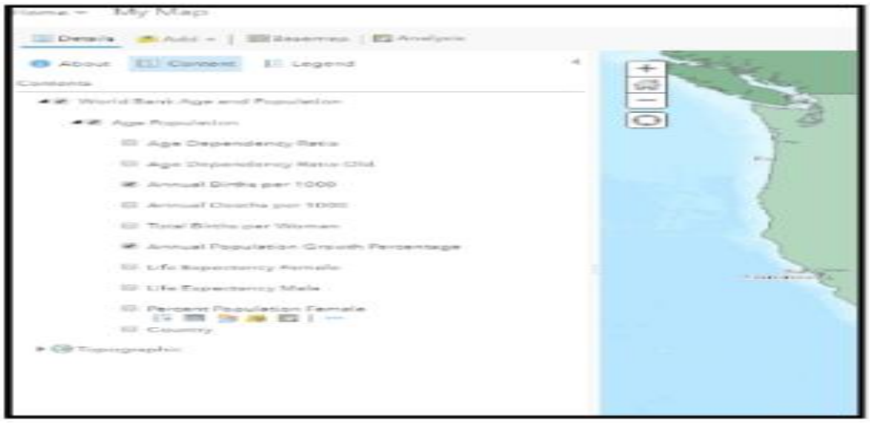


- Where are the high infant mortality rates located, and on which continent?
- What are the infant mortality rates for Kuwait, Arabian Gulf countries, and Arabian countries? Where are the high and low infant mortality rates located?

Activity 3

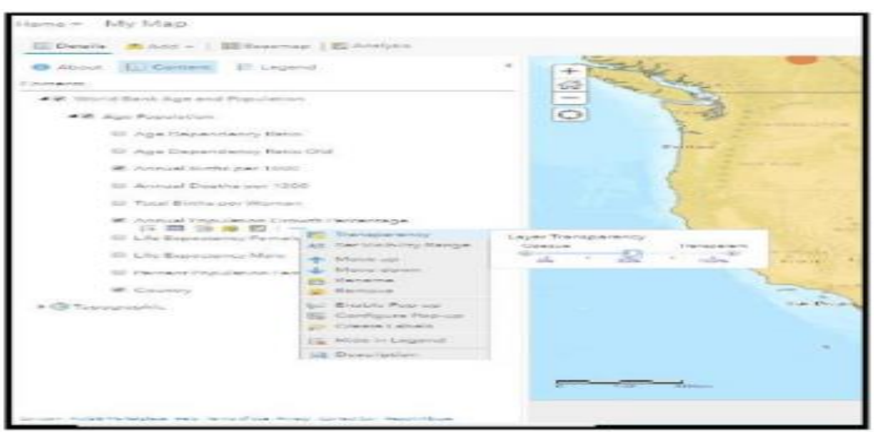
<u>Explore: The Relationship between Population Growth and Basic Population Concepts</u>

Turn off all layers except the **Annual Population Growth** and **Annual Births per 1,000** layers.



In the **Annual Births per 1,000** layer, click **Change Style**, select **Counts and Amounts**, and then click **Done**.

On the **Annual Population Growth** layer, click M**ore Options** and adjust the **Transparency** to 50%.

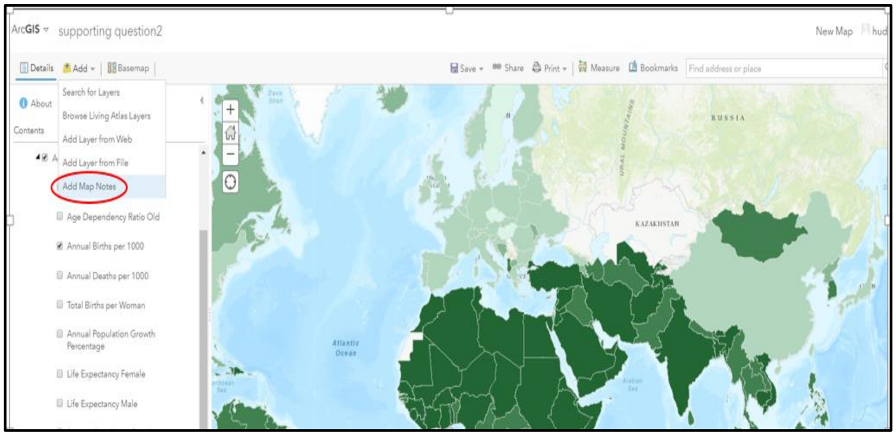


- The map shows two layers: **Annual Population Growth** and **Annual Births per 1,000**. Analyze the relationship between these layers and answer the following question: What are the relationship between population growth and birth rate? Support your answer with examples (for at least 3 countries).

- Turn off the **Annual Births per 1,000** layer, and turn on the **Births per Woman** layer. Then click **Change style**, select **Counts and Amounts**, click **Done**, and answer the following question: What is the relationship between population growth and fertility rate? Support your answer with examples (for at least 3 counties).

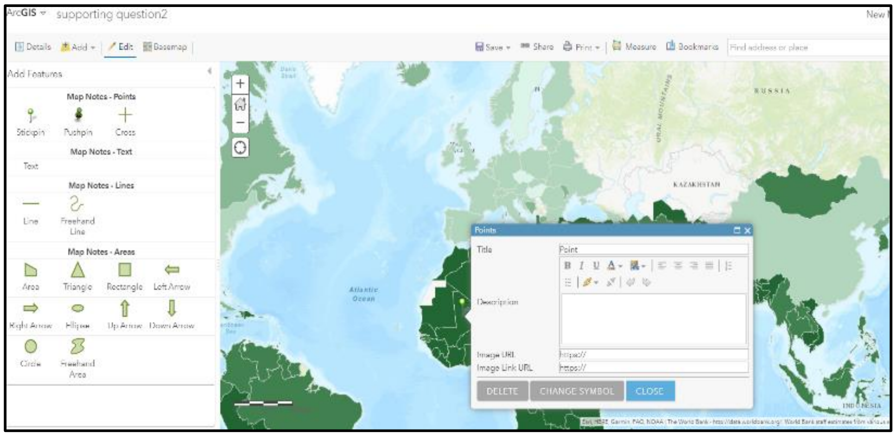
- Select one country with 'high' fertility and do a Google search to discover the underlying causes behind this phenomenon.

- Go to **Add**, then click **Add Map Notes**.



- Pick the type of Map Notes desired. **Map Notes-Points** are the easiest type to start.

- Click the spot on the map to position the map note (on the country you chose). The place can be changed by dragging the map note to the perfect spot.



- In the text box, write the causes of high fertility rate, and add the link(s) for the source of this information.

- Turn off all layers except the **Population Growth Rate** and **Life Expectancy** layers. Compare these layers, and answer the following question with your partner: What is the relationship between population growth rate and life-expectancy? Support your answer with examples.

- Select a country with 'low' life expectancy and do a Google search to discover the underlying causes behind this phenomenon (bookmarking the references as in previous steps).

Activity 4

Analyze: Education Level & Population Growth

- Create a new spreadsheet.

- Fill the fields for cells A1 to I1 as shown below:

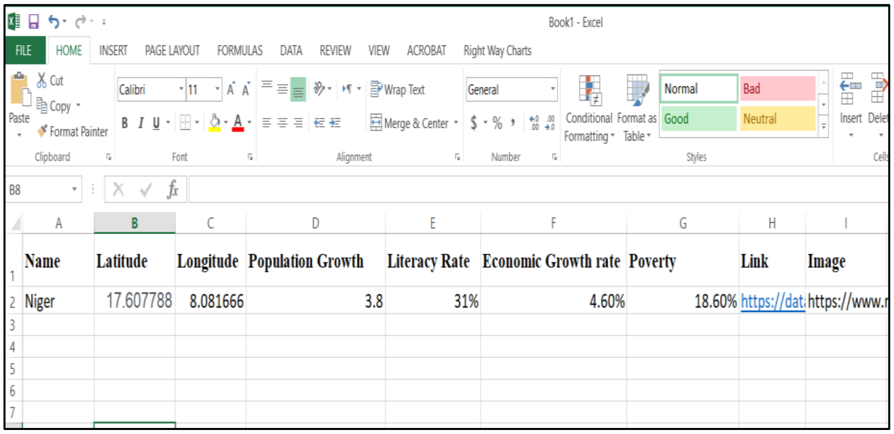
Name	Latitude	Longitude	Health Expenditure	Literacy Rate	Poverty	Link	Image

- Go to https://www.latlong.net/, and find the Latitude and Longitude for the following countries: Niger, Oman, Poland, Georgia, Japan, France, and Germany.

- Go to https://data.worldbank.org/, then search for the population growth, percentage of health expenditure, poverty, and literacy rates for each country.

- Copy and paste the web-address for the World Bank website in the cell for Link.

- Do a Google-search for images that effectively describe each country, making sure to copy and paste the address for these images.



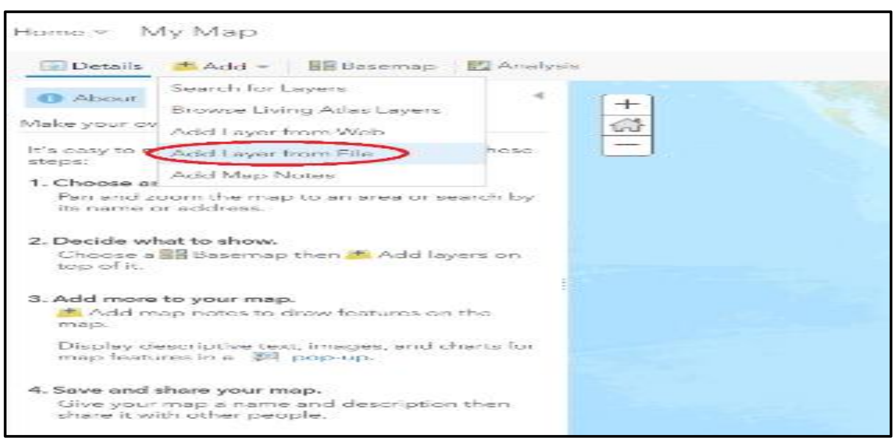
- Save the file in a .CSV (Comma-Separated Values) format and make sure students store the file on their computer or cloud drive.

- Go to www.arcgis.com

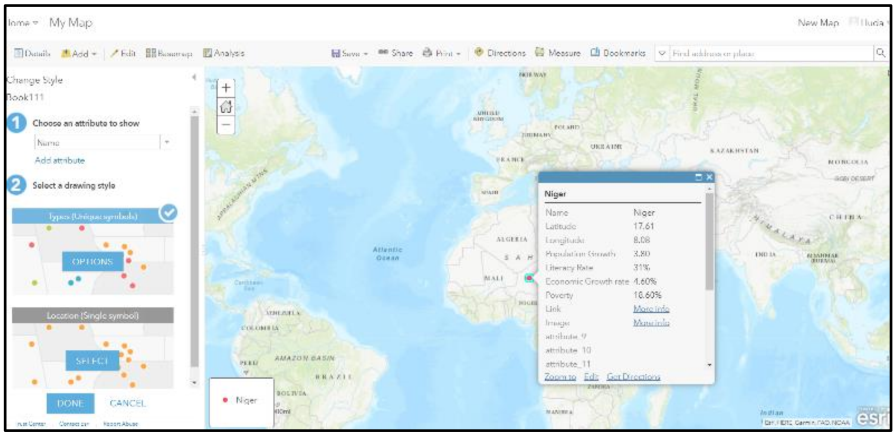
- Log in to a public account

- Click on **Map**

- Choose **Add Layer** from **File.**

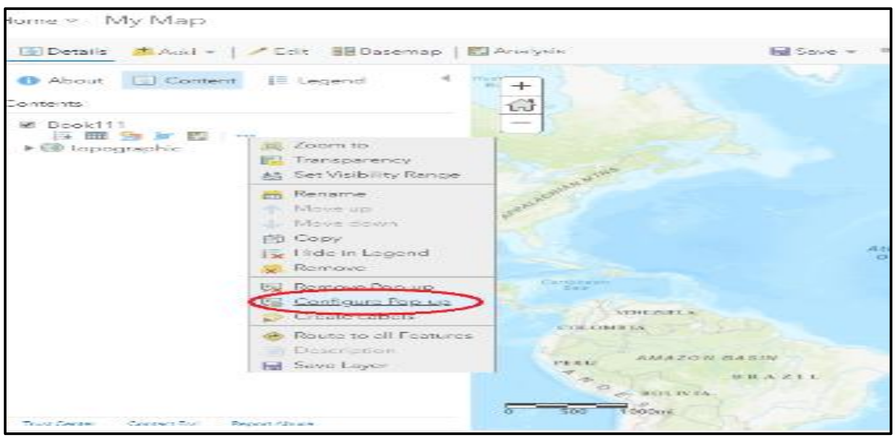


- Choose **Import Layer.**



- Click on the created layer, and choose the **More Options** icon.

- Click **Configure Pop-Up.**



- Click on the **Configure Attributes** link.

- Make sure only population growth, health expenditure, literacy and poverty rates are checked in the display column.

- Configure **Pop-up Media** by clicking on **ADD→ Image**

- In the URL field, **Add {Image}**
- In the Link field, **Add {Link}**

- Choose **OK**, and save the map

- Show the information on each country.

- With your partner, classify the previous country with the data required in the chart below:

Population growth rate	High Population Growth	Low Population Growth	Zero Population Growth	Negative Population Growth
Countries				
Characteristics				

- What are the characteristics of high, low, zero, and minus population growth countries?

- Do a Google-search about zero and negative population growth rates. Read about these countries and discuss your understanding with your partner.

Activity 5

Act: Story Map Journal

Continue your story map journal by adding slides that describe the causes of world population growth (work with your partner). Before you begin, please read the story map journal instructions and rubric sheet very carefully.

Material B

Map Journal Instructions & Rubric

Continue your map journal by adding slides that show the causes behind world population growth (work with your partner). Support your Story Map Journal with GIS maps, examples, images and data.

Consider the following instructions when working in your journal:

Mention at least 3 or 4 of the causes behind world population growth.
Mention actual countries with supporting data, images, and maps.
Your work should have at least one map and one image.
The following Rubric will be used to evaluate your work:

	Below Standard	**Adequately Meets Standard**	**Exceeds Standard**	**Exemplary**
Organization	Confusing, and many ideas and concepts are missing	Somewhat organized; contains a few ideas and concepts related to the supporting question.	Thoughtfully organized, and contains most of the ideas and concepts related to the supporting question.	Well organized, and contains all concepts and ideas related to the supporting question.
Use of color/ GIS maps/ images/ graphs	Students use little color and don't use images, GIS maps or graphs to illustrate connections with ideas.	Students use obvious color with images to illustrate some ideas.	Students use effective color with GIS maps and images to illustrate most of their ideas.	Students use multiple colors and include images, GIS maps, and graphs to illustrate each of their ideas.
Content	Mentions only one reason for rapid population growth without presenting evidence or examples	Mentions two reasons for rapid population growth with few examples or supporting evidence	Mentions three reasons for rapid population growth using examples and supporting evidence.	Mentions four reasons for rapid population growth using examples and abundant evidence.
Presentation	Poor knowledge of subject, low ability to communicate with audience, and speaks too quietly.	Below average subject knowledge. Below average communication. Speaks quietly.	Adequate subject knowledge. Good communication. Speaks with adequate volume.	Above average subject knowledge. Excellent communication. Speaks confidently.

Material C

Peer Review Activity Instructions

Now that you have added slides to your story map journal, it is time to share your work with other groups to get feedback which will improve your work. Follow the instructions below:

Click the **Share** button near the top of the map journal.

- Now click **Public**, so everyone can see or search for your map journal
- Share you map journal with others by copying the link provided in the box.
- To receive feedback, send your map journal link to the other groups. Each group will meet and take turns providing feedback to the others. Now fill out the peer evaluation form. After completing the feedback forms, each group will revise their map journal to reflect the notes and suggestions they received from other classmates. Now send your updated map journal to your teacher so they can evaluate your work.

Material D

Peer Evaluation Form

Your names:
Pair names:

Please fill out this rubric honestly, being as accurate as you can. Be positive but direct when giving feedback. Point to specific examples in the map journal that need improvement. Give appropriate suggestions for the other group to improve their work. Please provide an explanation for the rubric score that you have given to your peers on the reverse side of this sheet.

Formative Performance Task 2 - Story Map Journal Rubric

	Below Standard	**Adequately Meets Standard**	**Exceeds Standard**	**Exemplary**
Organization	Confusing, and many ideas and concepts are missing	Somewhat organized; contains a few ideas and concepts related to the supporting question.	Thoughtfully organized, and contains most of the ideas and concepts related to the supporting question.	Well organized, and contains all concepts and ideas related to the supporting question.
Use of color/ GIS maps/ images/ graphs	Students use little color and don't use images, GIS maps or graphs to illustrate connections with ideas.	Students use obvious color with images to illustrate some ideas.	Students use effective color with GIS maps and images to illustrate most of their ideas.	Students use multiple colors and include images, GIS maps, and graphs to illustrate each of their ideas.
Content	Mentions only one reason for rapid population growth without presenting evidence or examples	Mentions two reasons for rapid population growth with few examples or supporting evidence	Mentions three reasons for rapid population growth using examples and supporting evidence.	Mentions four or more reasons for rapid population growth using examples and abundant evidence.
Presentation	Poor knowledge of subject, low ability to communicate with audience, and speaks too quietly.	Below average subject knowledge. Below average communication. Speaks quietly.	Adequate subject knowledge. Good communication. Speaks with adequate volume.	Above average subject knowledge. Excellent communication. Speaks confidently.

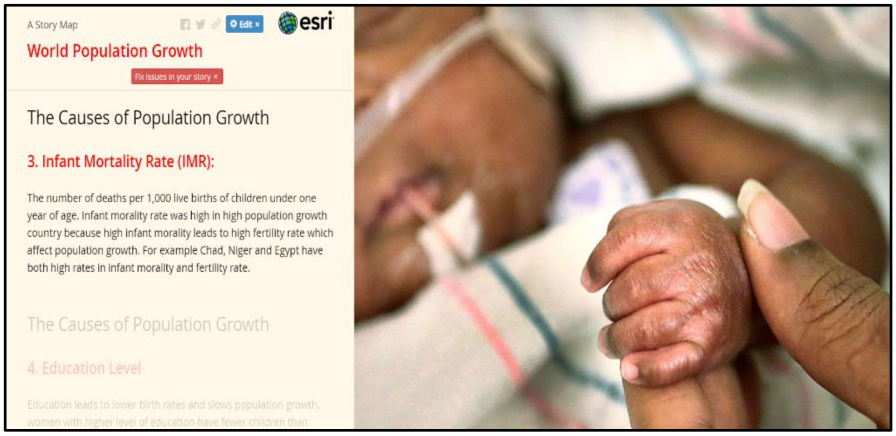
Material E

A model of Supporting Question #2 Map Story Journal

Slide 1

Slide 2

Slide 3



Slide 4

Slide 5

APPENDIX F4

Supporting Question #3 Materials

<u>Material A</u>

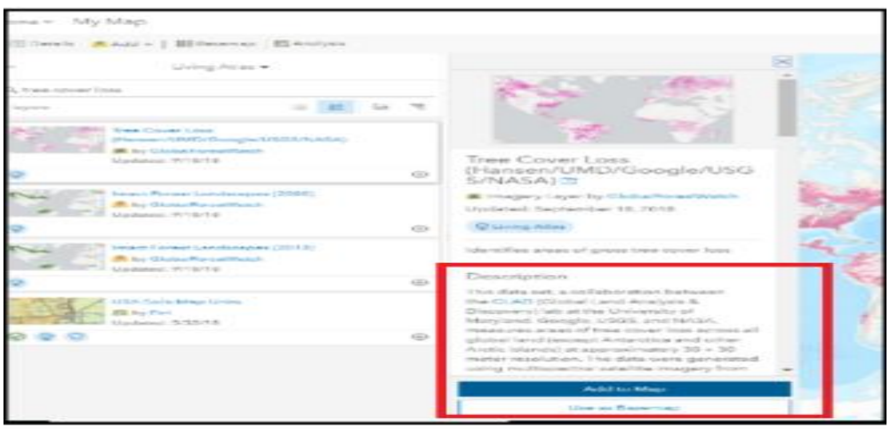
Step-by-Step Instructions & Questions

Activity 1
<u>Ask: The Impacts of Rapid Population Growth</u>

What do you already know about the consequences of rapid population growth? What do you want to know? Each pair creates their own questions

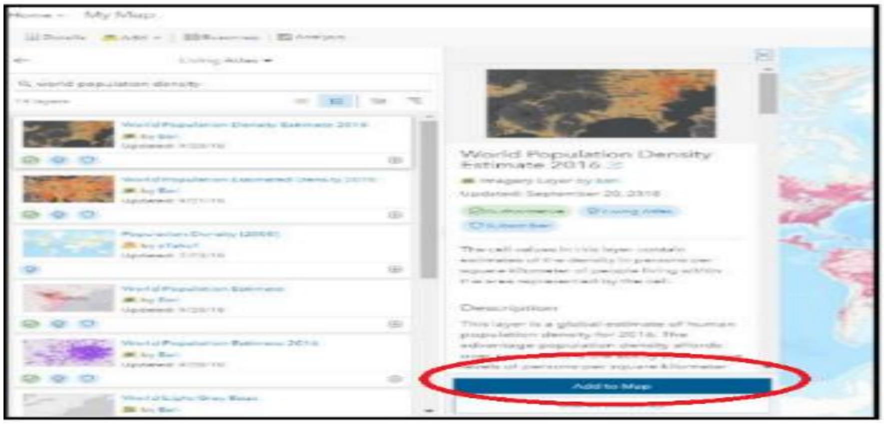
Activity 2
<u>Acquire: Tree Cover Loss & Population Density</u>

- Open your ArcGIS account→ Click **Add**→ Write “Tree Cover Loss” in the search box → click **Add Map**.



- Discuss your notes with your partner, and answer the following question: What do you observe?

- Click **Add**→ Write “World Population Density” in the search box → click **Add Map**



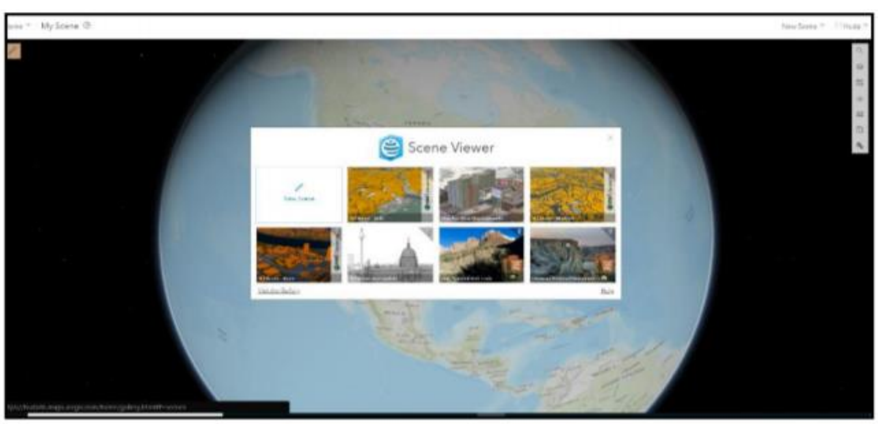
- Read the layer description, and answer the following questions: Are there any relationships between population density and tree cover loss? What are they?

Activity 3

Explore: World Population 3D map

- Click **Home**→ Choose **Scene**

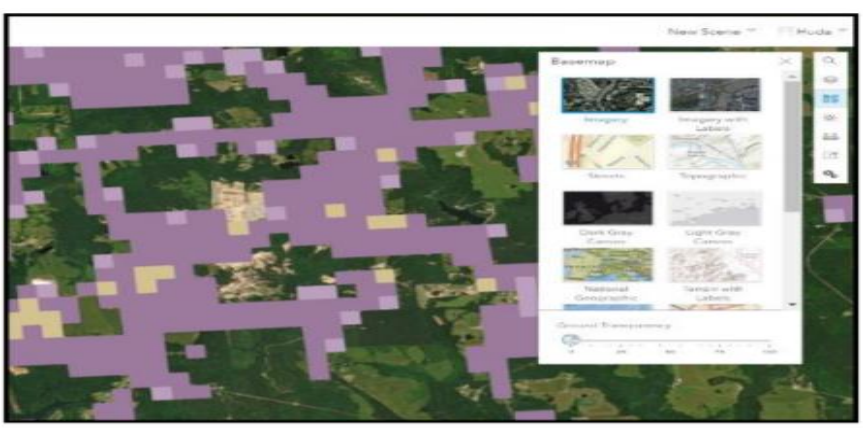
- Click **New Scene**



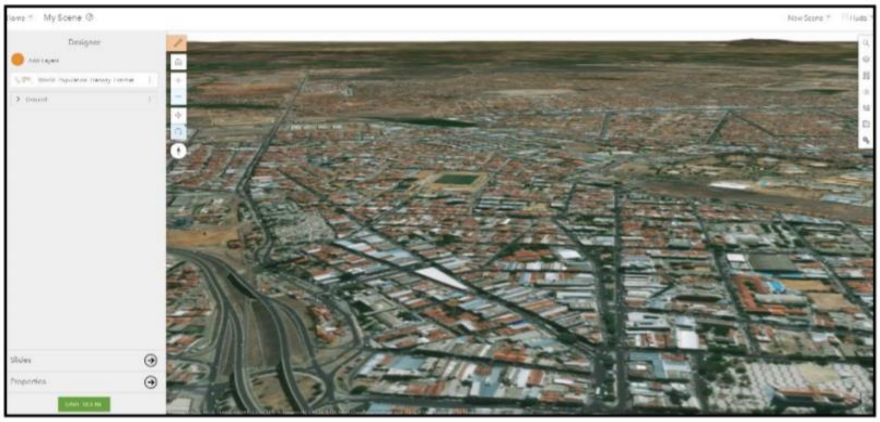
- Click **Add Layer**

- Add World Population Density map→ click **Done**

- Choose the base map’s imagery



- Click on the high density areas→ zoom in



- Answer the following questions:

  - What do you observe?
  - How may population affect the environment?
  - Discuss your answers and notes with your partner.

Activity 4

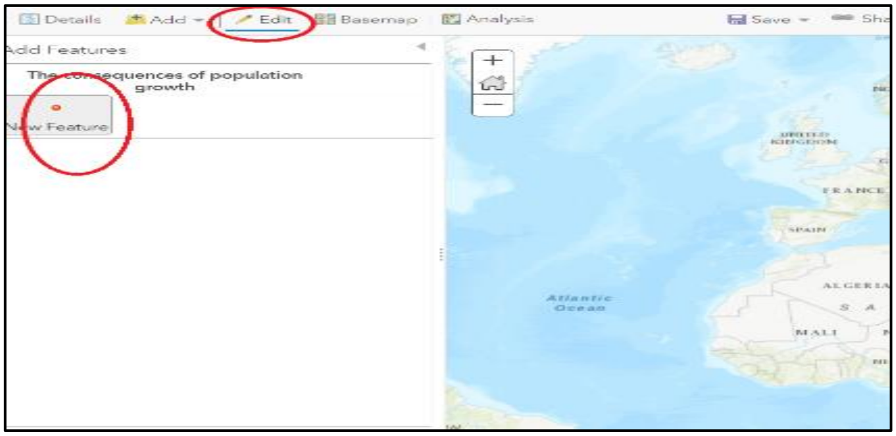
Analyze: The consequences of population growth

- Go to http://arcg.is/0rbXKH

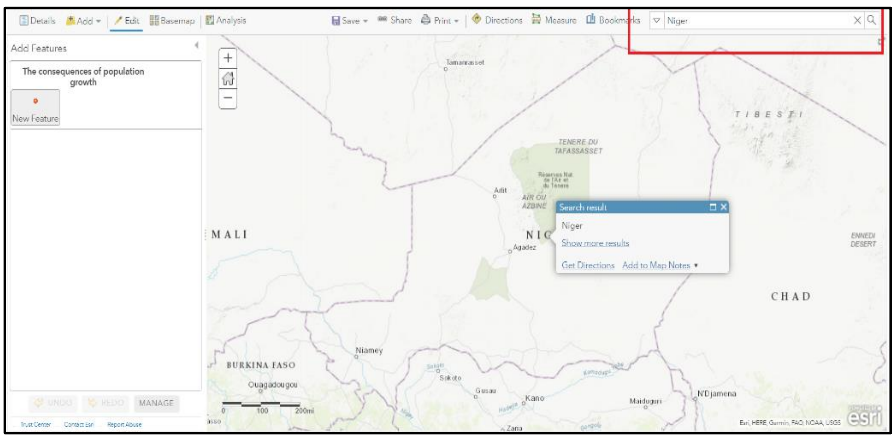
- Use the **Edit** map features (Points) to show the following places:

High Population Growth	Low Population Growth	Zero Population Growth	Minus population growth
Chad Oman	Germany United States	Poland Georgia	Bulgaria Greece

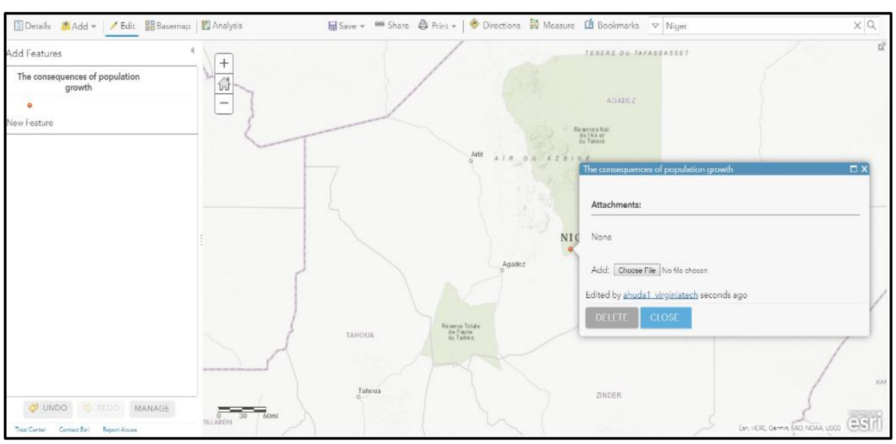
- Click **Edit** → choose **Points**



- Go to **Search** on the toolbar → Type a country's name; for example "Niger"

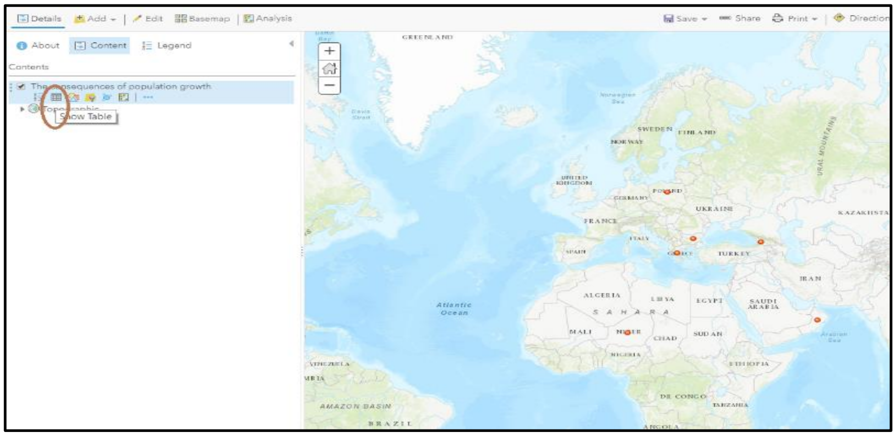


- Click on the place to add a point

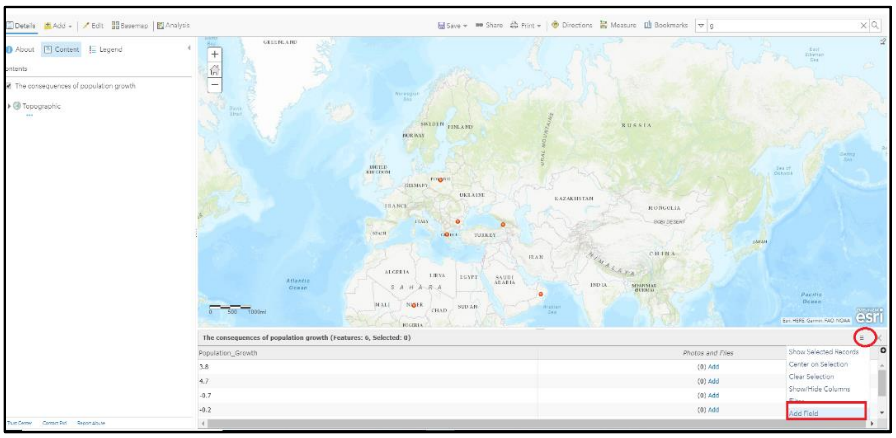


- Repeat the previous steps for each country (you must add six countries)

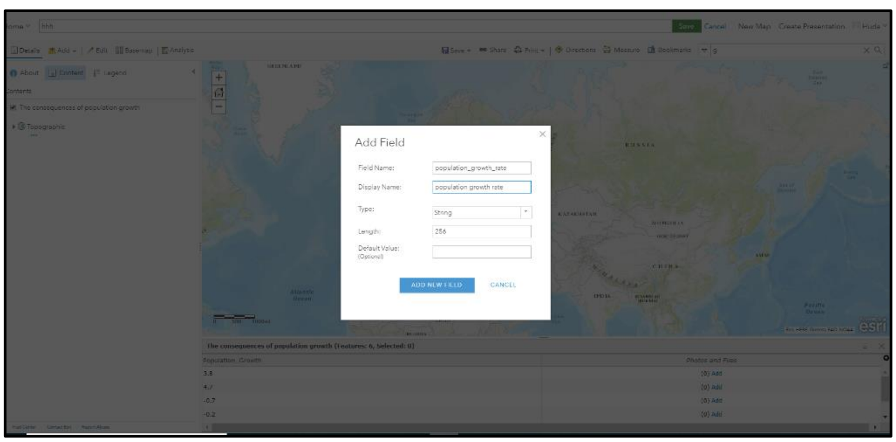
- On the newly created layer, click **Show Table**



- Click **Options**→ Choose **Add Field**



- On the **Field Name**, Type "Population_Growth". On **Display Name**, Type: "Population Growth Rate" → Click **Add New Field**



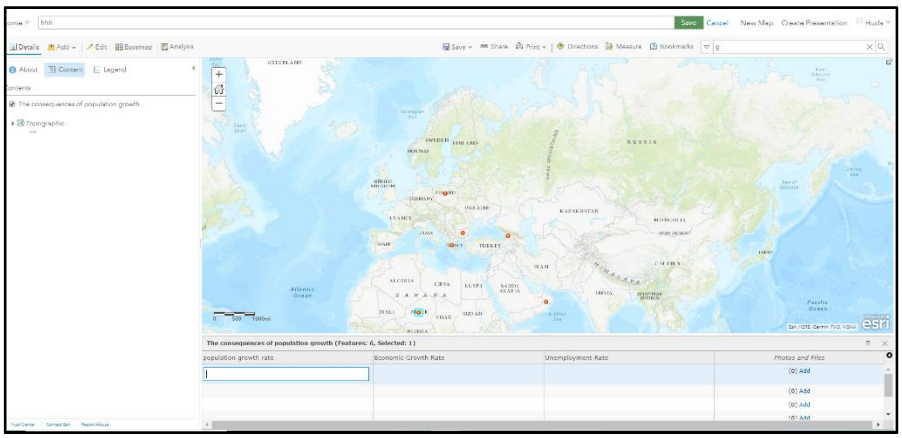
- Click **Add Field** → On the **Field Name**, type "Economic_Growth". On **Display Name**, type "Economic Growth Rate" → Click **Add New Field**

- Click **Add Field** → On the **Field Name**, type "Poverty". On **Display Name**, type "Poverty Rate" → Click **Add New Field**

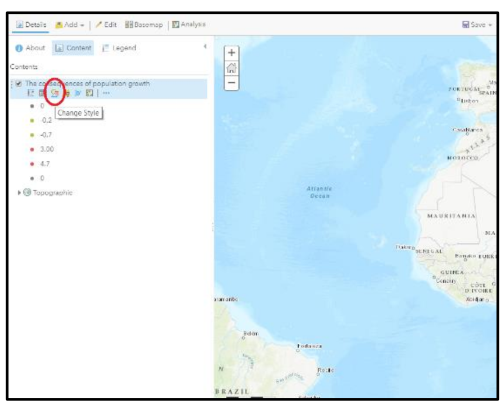
- Click **Add Field** → On the **Field Name**, type "Unemployment". On **Display Name**, type "Poverty Rate" → Click **Add New Field**

- Click **Add Field** → On the **Field Name**, type "Human Development Index". On **Display Name**, type "Poverty Rate" → Click **Add New Field**

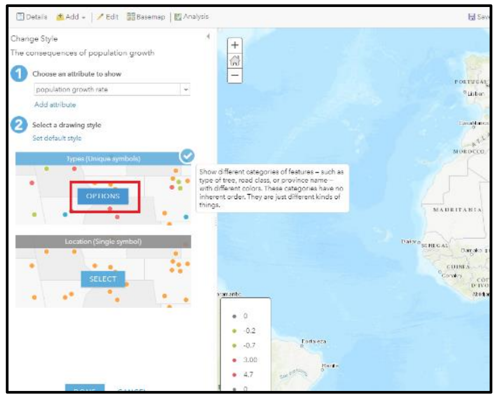
- Add the required information in each field for each country by using the World Bank Data in https://data.worldbank.org/



- Click **Change Style**

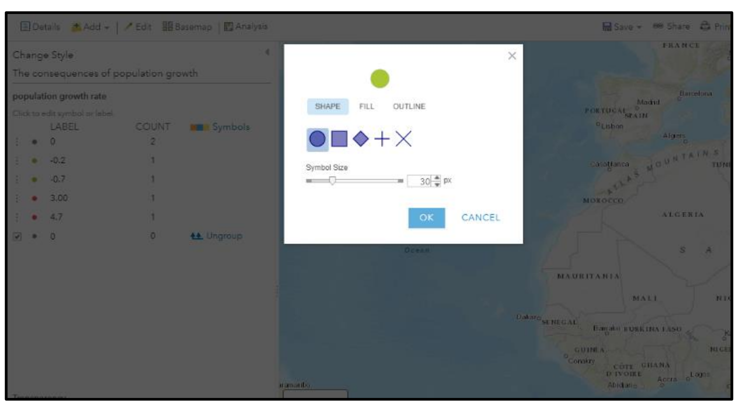


- Click **Types (Unique Symbols)** → Choose **Options**

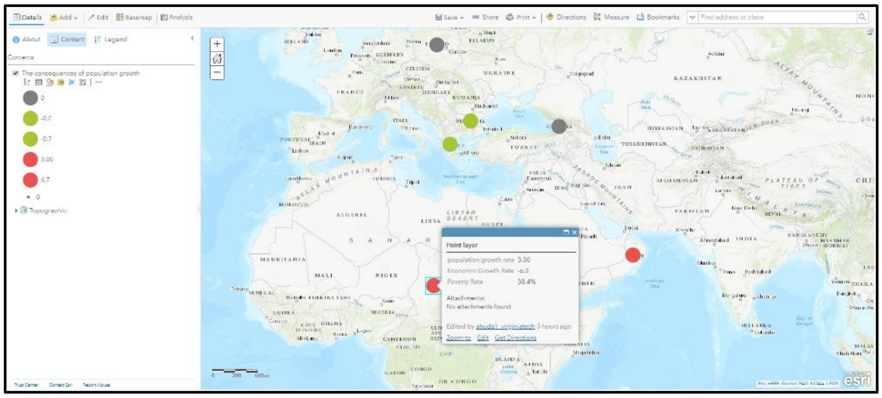


- Change the color for high population growth rate countries to Red, the color for low population growth rate countries to Green, and the color for zero population growth rate countries to Gray.

- Click on the Symbols → Change the symbol shapes to ○, and change the size to 30



- Click on each symbol and read the data for each country



- Discuss your notes with your partner, and then answer the following questions:

    - Is there a relationship between population growth rate and poverty? What is it?
    - Is there a relationship between population and economic growth rates? What is it?
    - Is there a relationship between population growth and unemployment? What is it?
    - Is there a relationship between population growth and human development? What is it?

Activity 5

Act: Story Map Journal

Continue your story map journal by adding slides that show the causes behind world population growth (work with your partner). Before working on your story map, please carefully read the story map journal instructions and rubric sheet.

Material B

Map Journal Instructions & Rubric

Continue your story map journal by adding slides that show the consequences of world population growth (work with your partner). Support your Story Map Journal with GIS maps, examples, images and data. Consider the following instruction when working on your journal:

Explain the important consequences of overpopulation with examples, maps, and images.

Mention specific countries with relevant data, images, and maps.

Your work should have at least one map and one image.

The following Rubric will be used to evaluate your work:

Map Journal Rubric

	Below Standard	**Adequately Meets Standard**	**Exceeds Standard**	**Exemplary**
Organization	Confusing, and many ideas and concepts are missing	Somewhat organized; contains a few ideas and concepts related to the supporting question.	Thoughtfully organized, and contains most of the ideas and concepts related to the supporting question.	Well organized, and contains all concepts and ideas related to the supporting question.
Use of color/ GIS maps/ images/ graphs	Students use little color and don't use images, GIS maps or graphs to illustrate connections with ideas.	Students use obvious color with images to illustrate some ideas.	Students use effective color with GIS maps and images to illustrate most of their ideas.	Students use multiple colors and include images, GIS maps, and graphs to illustrate each of their ideas.
Content	Mentions one consequence of overpopulation, but without evidence or examples	Mentions two consequences of overpopulation, but with few examples or supporting evidence	Mentions three consequences of overpopulation while using examples and supporting evidence.	Mentions four or more consequences of overpopulation while using examples and abundant evidence.

Material C

Peer Review Activity Instructions

Now that you have added slides to your story map journal, it is time to share your work with other groups to get feedback which will improve your work. Follow the instructions below:

- Click the **Share** button near the top of the map journal.
- Now click **Public**, so everyone can see or search for your map journal
- Share you map journal with others by copying the link provided in the box.
- To receive feedback, send your map journal link to the other groups. Each group will meet and take turns providing feedback to the others. Now fill out the peer evaluation form. After finishing the feedback forms, each group will revise their map journal to reflect comments they received from classmates. Now send your updated map journal to your teacher so they can evaluate your work.

Material D

Peer Evaluation Form

Your names:
Pair names:

Please fill out this rubric honestly, being as accurate as you can. Be positive but direct when giving feedback. Point to specific examples in the map journal that need improvement. Give appropriate suggestions for the other group to improve their work. Please provide an explanation for the rubric score that you have given to your peers on the reverse side of this sheet.

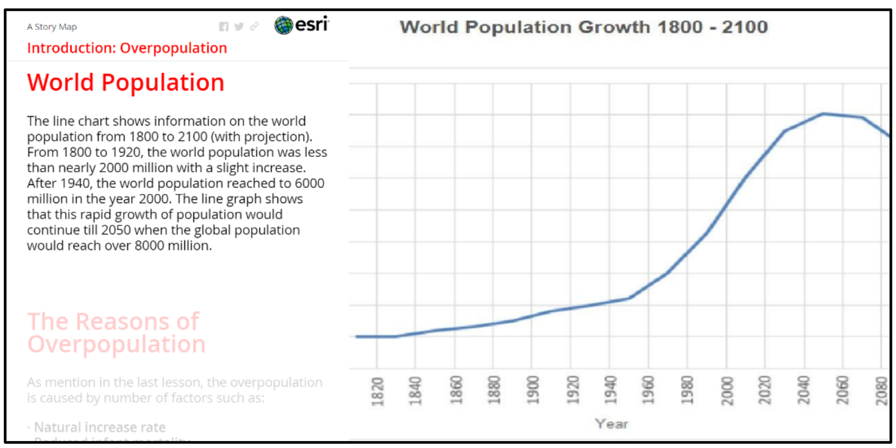
	Below Standard	**Adequately Meets Standard**	**Exceeds Standard**	**Exemplary**
Organization	Confusing, and many ideas and concepts are missing	Somewhat organized; contains a few ideas and concepts related to the supporting question.	Thoughtfully organized, and contains most of the ideas and concepts related to the supporting question.	Well organized, and contains all concepts and ideas related to the supporting question.
Use of color/ GIS maps/ images/ graphs	Students use little color and don't use images, GIS maps or graphs to illustrate connections with ideas.	Students use obvious color with images to illustrate some ideas.	Students use effective color with GIS maps and images to illustrate most of their ideas.	Students use multiple colors and include images, GIS maps, and graphs to illustrate each of their ideas.
Content	Mentions one consequence of overpopulation, but without evidence or examples	Mentions two consequences of overpopulation, but with few examples or supporting evidence	Mentions three consequences of overpopulation while using examples and supporting evidence.	Mentions four or more consequences of overpopulation while using examples and abundant evidence.

<u>Material E</u>

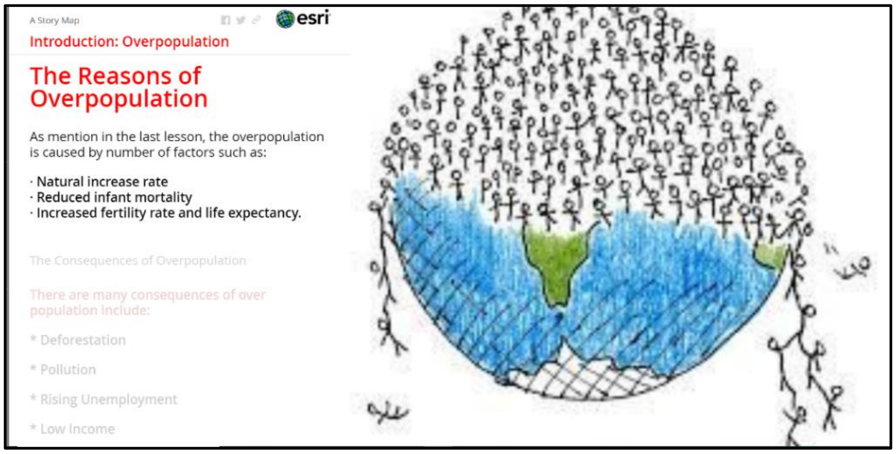
A model of Supporting Question #3 Map Story Journal

Slide 1

Slide 2

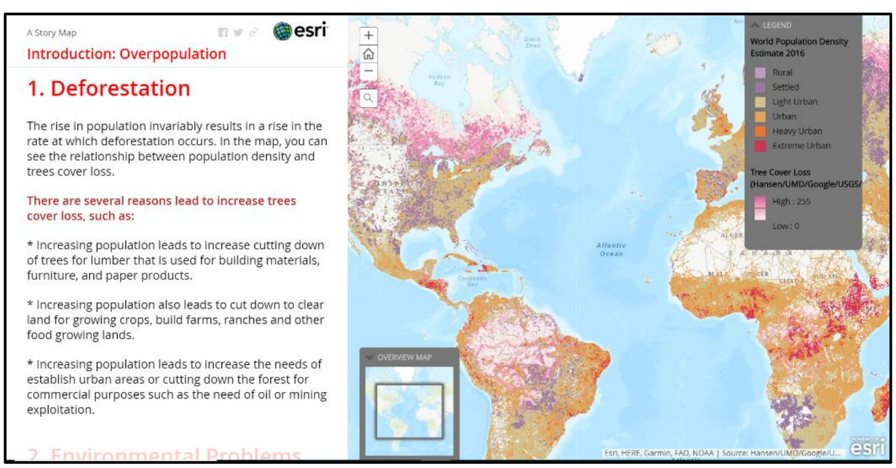


Slide 3

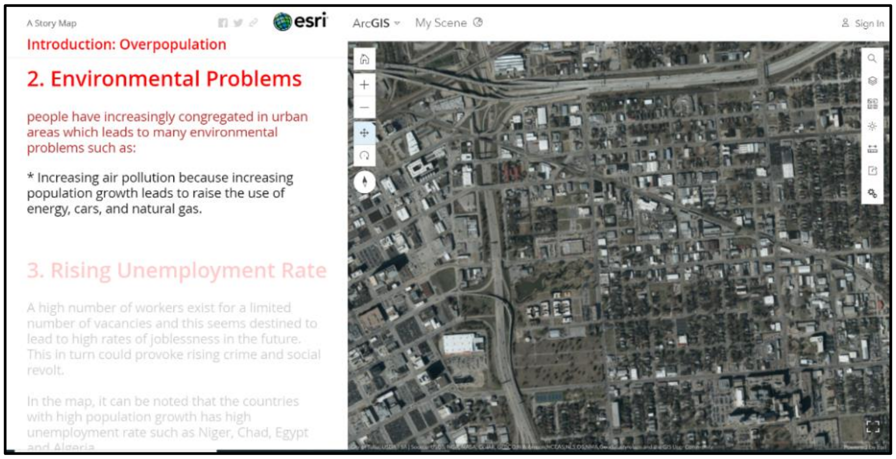


Slide 4

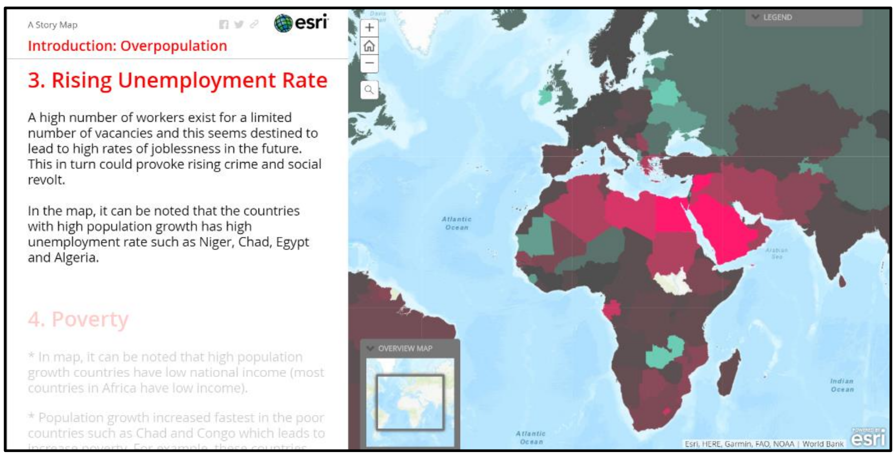
Slide 5



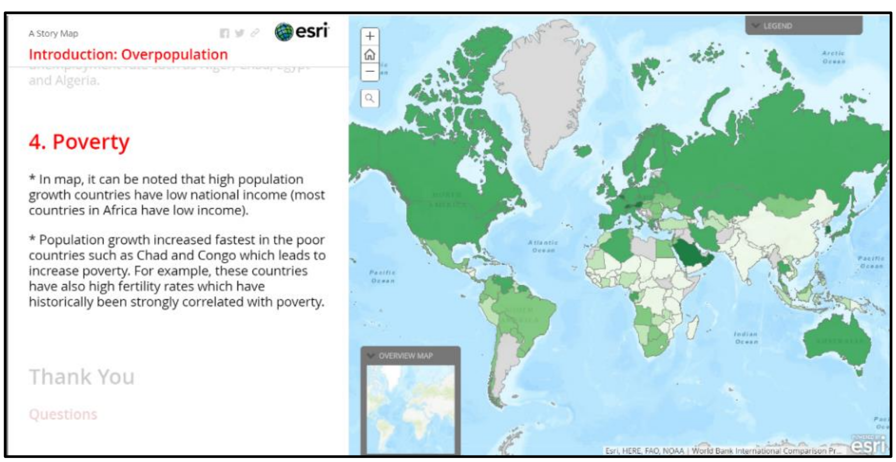
Slide 6



Slide 7



Slide 8



APPENDIX F5

Summative Performance Task Materials

Material A

Argumentative Essay Instructions

Purpose

For this activity, you will work in groups to construct an argumentative essay in which you answer the following question, “Is population growth good or bad for human development?” You should think specifically about the effects of human population growth upon our planet.

Process

Your argument must be written in a story map format. You must begin by first choosing the type of story map you want to use. Then, as a group, you should brainstorm your ideas concerning the benefits and/or drawbacks of world population growth (use your notes from previous lessons). Third, collect and collate the evidence to support your viewpoints (GIS maps, graphs, and images). Finally, write your argument. Your argumentative essay must include the following components:

Introduction (2 to 3 sentences)
Claim (Point of view)
Evidence (supporting information - at least 3 to 4 facts)
Counterclaim (the opposing view's best argument)
Rebuttal (the weakness in the opponent’s argument)
Conclusion (a concise review)

Evaluation

Remember that your essay will be graded using the “World Population Essay Rubric.” You should review this rubric carefully before writing your essay. After completing your work, send your essay to the teacher for their comments and suggestions. Once this feedback is received, make the necessary revisions to your essay before resubmitting it to your teacher. Make sure that your argumentative essay includes all of the criteria required by the following rubric:

World Population Essay Rubric

	Inadequate 0	Developing 1	Proficient 2	Exceptional 3
Structure	Very poorly organized. Sections not connected, and do not fully address the question	Weak organization. Essay sections weakly connected, and inadequately address question	Well organized. Essay sections clearly connected, and mostly address the question.	Very well organized. Essay sections strongly connected, and fully address the question.
Claim	Off topic	Makes no clear claim	Makes clear claim	Makes clear, well-articulated claim
Evidence	No mention of GIS maps or 3D scene to support claim	Mentions one GIS map or 3D scene to support claim	Mentions two GIS maps or 3D scenes to support claim	Mentions three or more GIS maps or 3D scenes to support claim
Analysis	No illustration, text, facts, or data to demonstrate understanding.	Minimal use of examples (not text) explaining the evidence to support the claim.	Uses text to explain evidence and demonstrate understanding.	Uses analytical text to explain evidence. Clear demonstration of understanding.
Counterclaim	No mention of counterclaim.	Mentions counterclaim, but no explanation.	Mentions counterclaim with brief explanation.	Mentions counterclaim with clear explanation.
Accuracy	Major factual errors.	Makes more than three minor factual errors.	Makes two or fewer minor factual errors.	Makes no factual errors.
Use of color/ images/ graphs	Little use of color. No images/graphs to illustrate connection to ideas.	Students use obvious colors with images to illustrate some ideas.	Students use effective color using GIS maps and images to illustrate most of their ideas.	Students use multiple colors, with images, GIS maps, and graphs to illustrate all of their ideas.

Material B

Argumentative Essay Evaluation Form

Group Number:

Now that you have made your argument and received comments and suggestions about it from colleagues, it is time to assess your work by using the following criteria:

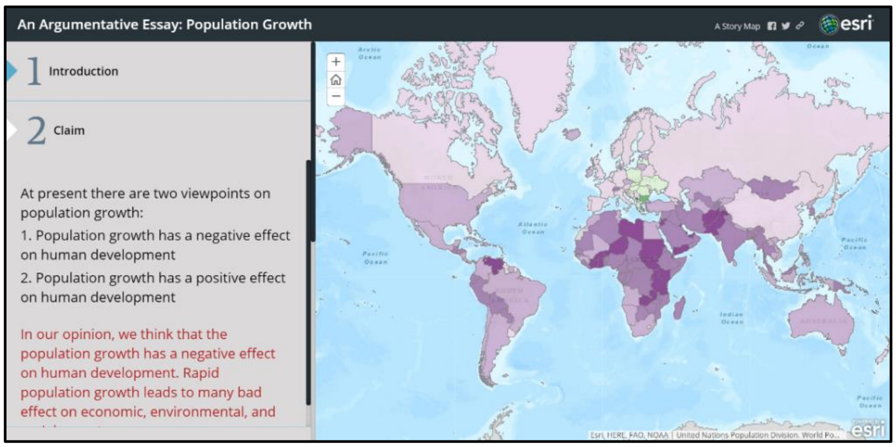
	Inadequate 0	**Developing 1**	**Proficient 2**	**Exceptional 3**
Structure	Very poorly organized. Sections not connected, and do not fully address the question	Weak organization. Essay sections weakly connected, and inadequately address question	Well organized. Essay sections clearly connected, and mostly address the question.	Very well organized. Essay sections strongly connected, and fully address the question.
Claim	Off topic	Makes no clear claim	Makes clear claim	Makes clear, well-articulated claim
Evidence	No mention of GIS maps or 3D scene to support claim	Mentions one GIS map or 3D scene to support claim	Mentions two GIS maps or 3D scenes to support claim	Mentions three or more GIS maps or 3D scenes to support claim
Analysis	No illustration, text, facts, or data to demonstrate understanding.	Minimal use of examples (not text) explaining the evidence to support the claim.	Uses text to explain evidence and demonstrate understanding.	Uses analytical text to explain evidence. Clear demonstration of understanding.
Counterclaim	No mention of counterclaim.	Mentions counterclaim, but no explanation.	Mentions counterclaim with brief explanation.	Mentions counterclaim with clear explanation.
Accuracy	Major factual errors.	Makes more than three minor factual errors.	Makes two or fewer minor factual errors.	Makes no factual errors.
Use of color/ images/ graphs	Little use of color. No images/graphs to illustrate connection to ideas.	Students use obvious colors with images to illustrate some ideas.	Students use effective color using GIS maps and images to illustrate most of their ideas.	Students use multiple colors, with images, GIS maps, and graphs to illustrate all of their ideas.

<u>Material C</u>

A model of Argumentative Essay

Slide 1

Slide 2



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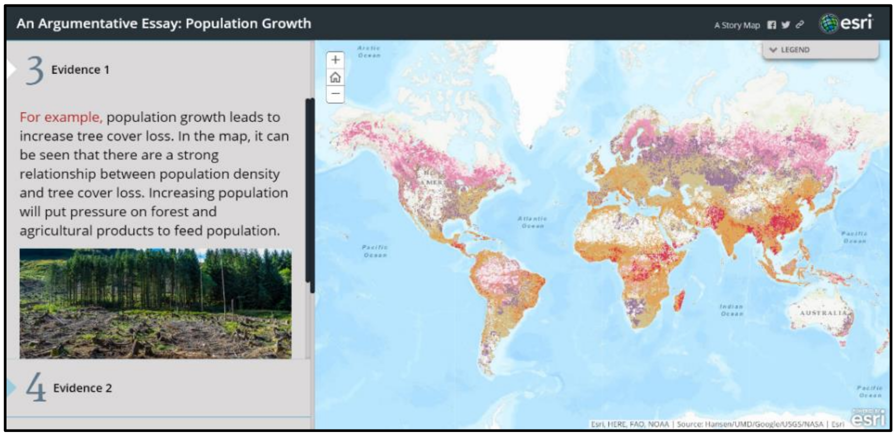

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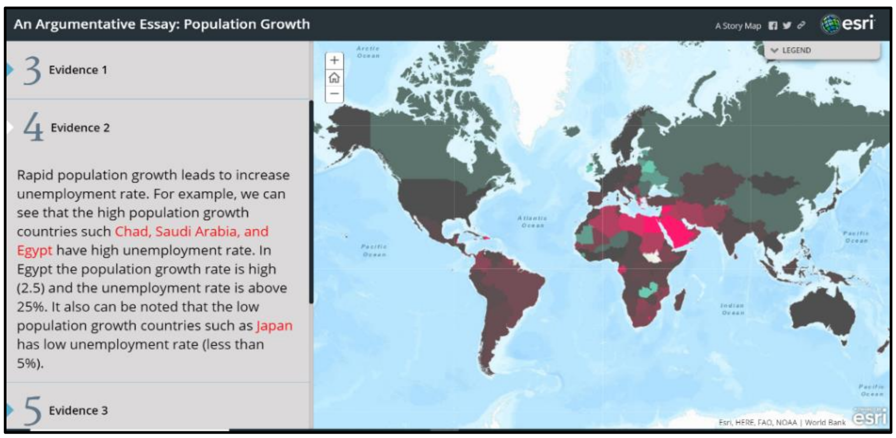

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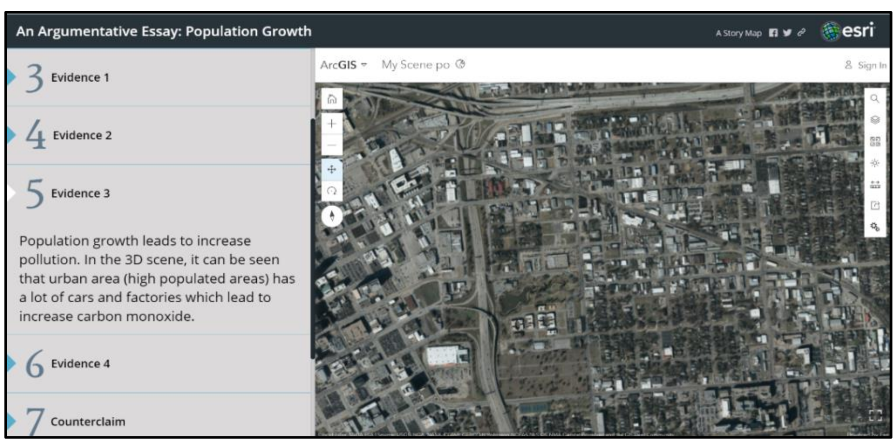
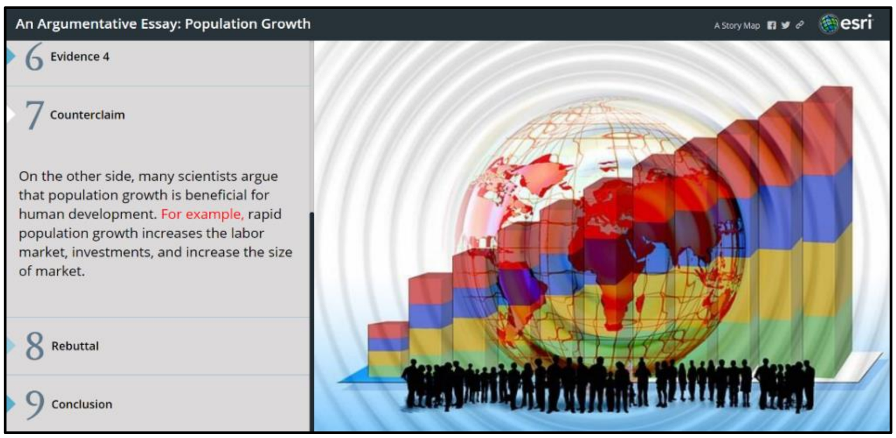


Slide 6

Slide 7



Slide 8

Slide 9


An Argumentative Essay: Population Growth
A Story Map
esri
6 Evidence 4
7 Counterclaim
8 Rebuttal
9 Conclusion
In conclusion rapid population growth can lead to problems in the form of putting pressure on natural resources, environmental pollution and degradation, and bad effects on economic level. Therefore, urgent steps need to be taken to manage human population growth to a level that can be managed well.

APPENDIX F6

Taking Informed Action Task Materials

Material A

Overview of GIS Project
Life by the Numbers: A Kuwait Case Study Project

Purpose

The project explores how the population has changed in Kuwait. By working with ArcGIS Online, each group must answer the guiding questions below. Follow the GIS Project guidelines to learn how to use ArcGIS Online. After completing your map and all activities, it is time to make your presentation. This presentation should answer the guiding question, with support from the GIS maps you created.

You can create your presentation in whatever format you wish, but remember that it will be graded against the "Project-based GIS Rubric". You should review this rubric carefully before starting. After completing your project, review your work to ensure that you have met all of the required criteria.

Happy projecting!

Project Resources
Kuwait Provinces Map
The Public Authority for Civil Information Data (http://stat.paci.gov.kw/)
Fieldwork

Guiding Questions
How has the population changed in Kuwait?
What are the effects of population growth in Kuwait?
What are the reasons behind population growth in Kuwait?
How can we control rapid population growth in Kuwait?

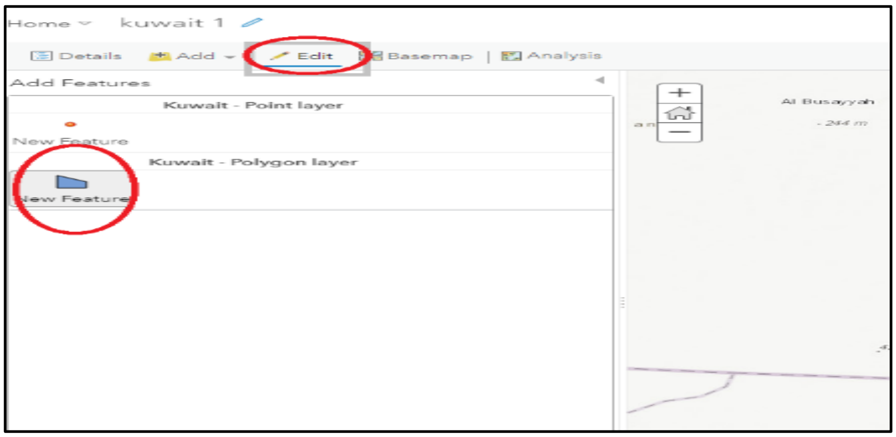
Material B

Project based GIS: Step by Step Instructions

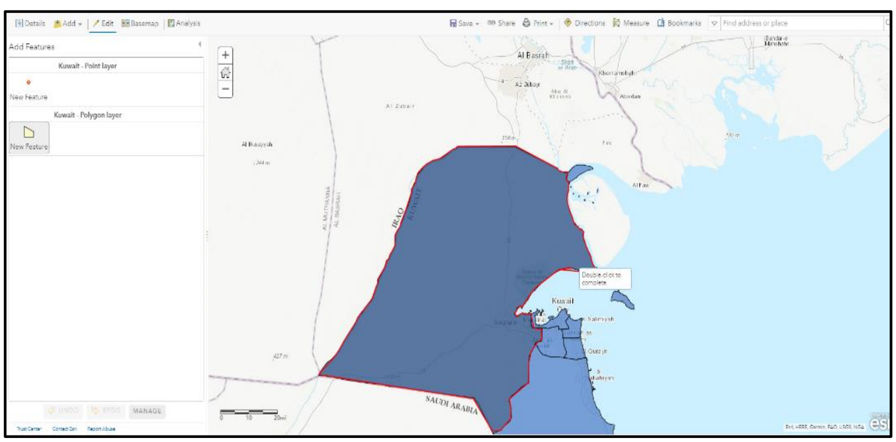
Activity 1. Create your own map

- Go to http://arcg.is/nmKmr

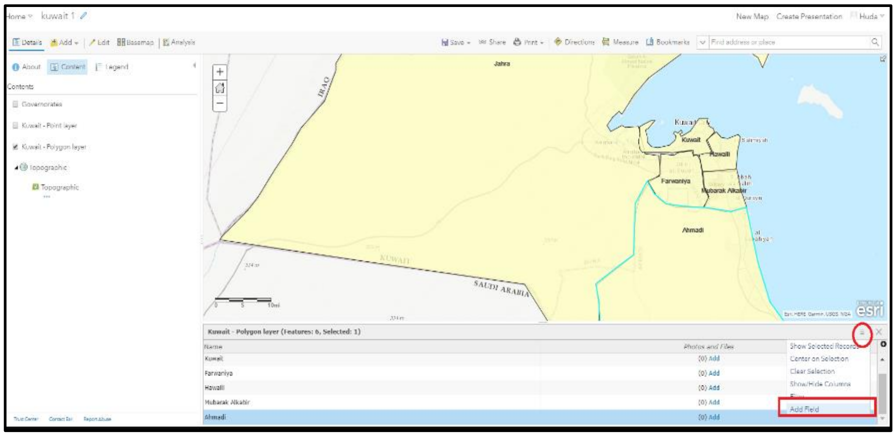
- Click **Edit** → Choose **Polygon**



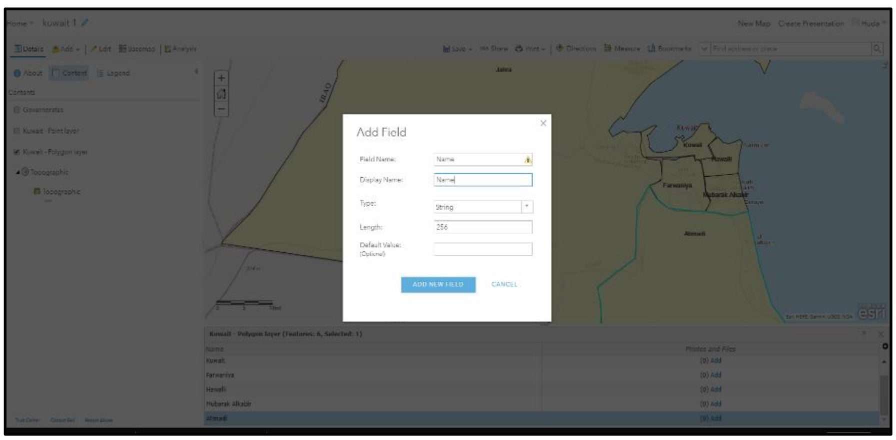
- Draw each province by placing the pointer at the location for the first point to start drawing→ Move the pointer to the next point and click→ Continue clicking at each corner of the shape until you have created the polygon. You have to create six polygons (one for each province).



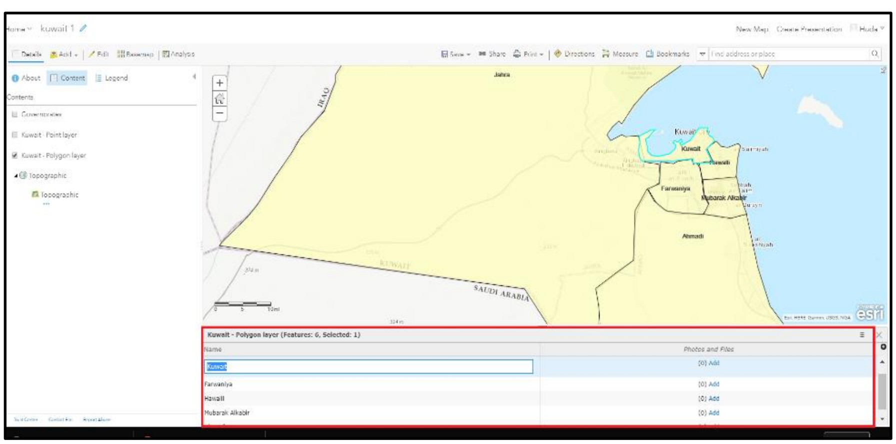
- Click **Table → Options → Add Field**



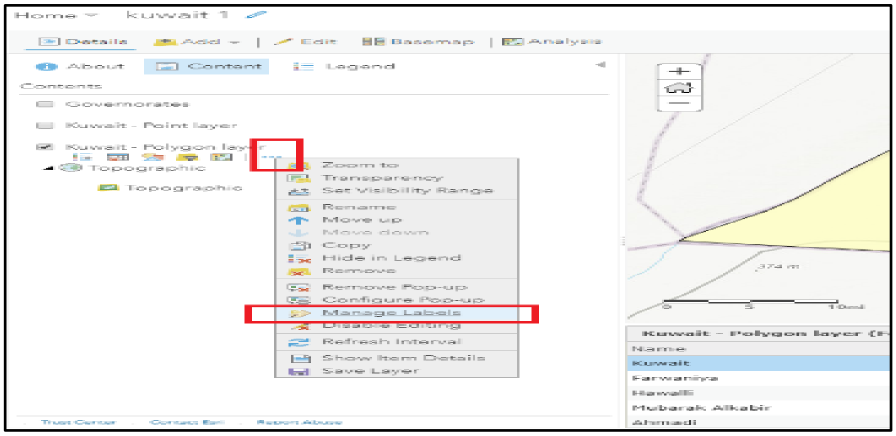
- On **Field Name,** type “Name”. On **Display Name,** type “Name” as well.



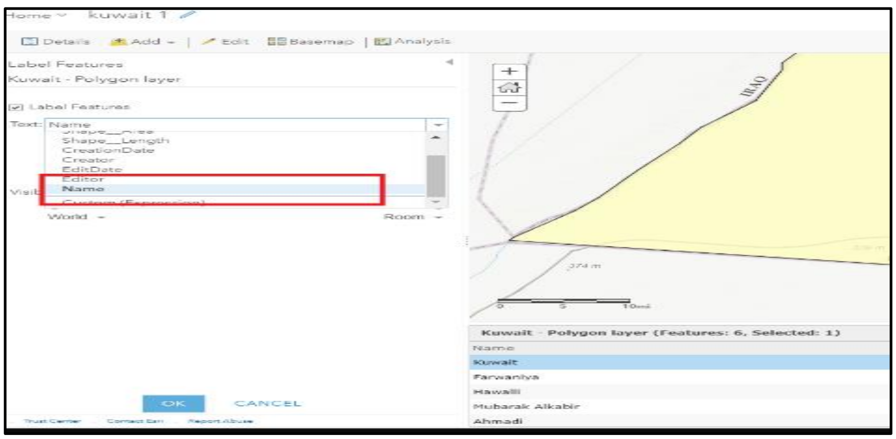
- On each polygon, type the name of the province it represents.



- On the polygon layer, click **More Options** → and then click **Create Labels**.

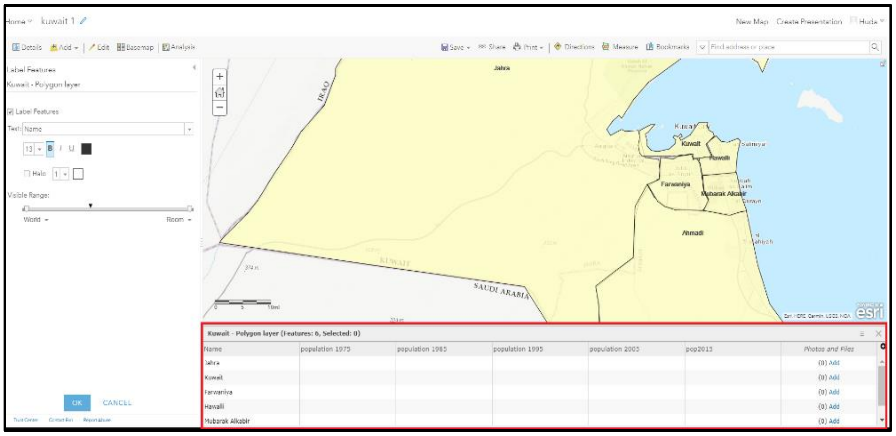


- On **Label Features**, choose **Name** to show the province names on your map.



Activity 2. Demographics

- Click **Table** → **Options** → **Add Fields** to add five fields (Population data for 1975, 1985, 1995, 2005, and 2015)

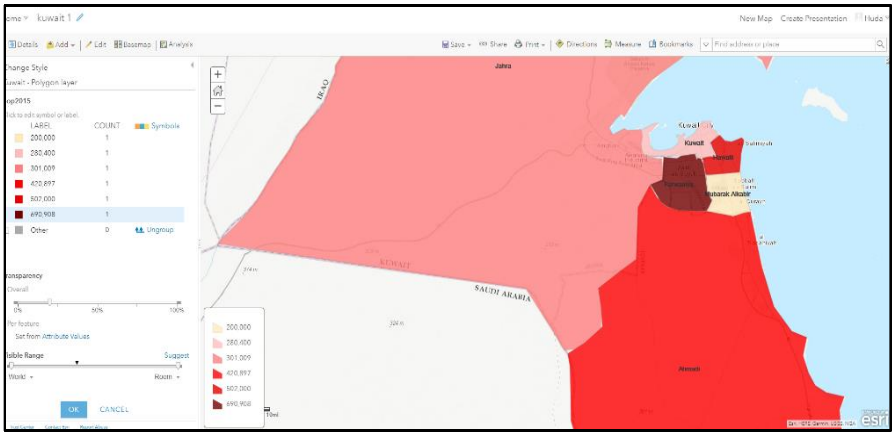


- Go to http://stat.paci.gov.kw/ to add the population data for each year in each province such as population growth, births, deaths, and fertility rates.

Activity 3. Spatial Representation

- On the polygon layer, click **Change Style** → on the attribute bar, choose **pop2015** → Choose **Types (Unique Symbols)**

- Click **Options** to change the color of each label. Choose a dark color to represent a highly populated province and a lighter shade for provinces with lower populations.



- See the map and discuss the following question with your group: Do all governorates in your country have the same population? Explain.

Activity 4. Population Growth

- On the polygon layer, click on each province to show details about population data from 1975 to 2015
- Discuss the following question with your group: Have population numbers increased over 35 years? Why? Explain. You can do a Google-search to identify the reasons behind population growth in Kuwait.

Activity 5. Fieldwork

Interview your grandparents or someone born before 1965, and ask them about how the population has changed in Kuwait? What reasons do they believe are behind these changes, and what associated consequences do they see? With your peers, summarize the results for these interviews.

- Open your map and insert the results of your interview by adding Map Notes.

- **<u>Geo-Form app:</u>** When you've returned home after the interview, go outside and take a photograph that you feel will help describe population growth in Kuwait.

  - Access to http://arcg.is/1n0WjK
  - Fill out the questions, then insert your picture and associated comments for the exact location on the map of Kuwait where you captured the image.
  - Return again to http://arcg.is/1n0WjK, scroll down and click 'view submissions'
  - Look at the pictures and comments made by your colleagues, and write 4 sentences to summarize what you saw and what you think? Describe the pictures, analyze the comments and write down your conclusions.

Assessment Phase. Demographer Role

As a demographer:

- Is population growth in Kuwait good or bad? Why? Provide some suggestions for controlling Kuwaiti population growth.

Action Phase. Writing an e-mail

- E-mail a city policymaker with your ideas to help better manage Kuwaiti population growth.

Material C

Presentation Instructions

After completing the previous steps, work with your group members to create a Power Point presentation summarizing project results. Each group will then have five minutes to run through their slide show in class, with a further five minutes allocated to post-presentation discussion where the other groups will evaluate your work, giving you valuable feedback. Your lecture should cover the following topics:

- Your GIS maps.
- Your interview procedure, data analysis process, and results.
- Your suggestions and ideas to plan population growth in Kuwait.
- Your Power Point presentation should be clear, answering all guiding questions, and it should include relevant visual aids as well as text.
- Talk through your Power Point presentation with a clear, confident voice.
- Clarify how your group collaborated in this project.
- Provide the opportunity for classmates from other groups to discuss and ask questions about your presentation.

Following the conclusion of your Power Point lecture, fill out the Self and Peer Evaluation forms for the GIS Group Project on the appropriate page.

Consider the following rubric when you work and create your project:

		Needs Work (1)	Competent (2)	Excellent (3)
GIS Map	GIS Map Activities	Completed minimal GIS map activities	Completed most GIS map activities	Completed all GIS map activities
	GIS Map Quality	Low quality: - No cartographic elements on map - Text and image sizes too small - Poor use of color	Medium quality: - Some cartographic elements appear on map - Text size good - used clear color and images	High quality - All essential cartographic elements on map - Text size good - used clear color and images
Interview		Interview results do not answer guiding questions.	Interview results answer one or two guiding questions.	Interview results answer all guiding questions
Demographer Role (e-mail)		Weak suggestions or ideas that offer no solutions to problems related to population growth.	Good suggestions or ideas that temporarily solve problems related to population growth.	Excellent suggestions or creative ideas that solve problems related to population growth.
	Organization	Poorly organized presentation	Loosely organized presentation	Presentation is organized and well laid out
	Content	Presentation fails to answer complete set of guiding questions, and does not use relevant evidence to support its thesis.	Presentation answers all guiding questions, but without using relevant evidence to support its thesis.	Presentation answers all guiding questions while using relevant evidence to support its thesis.
	Use of visual aids	No visual aids, or visual aids that are inappropriate. No mention of visual aids in the presentation.	Uses visual aids, but ones that are awkward and difficult to understand. No mention of visual aids in the presentation.	Uses effective and easily interpreted visual aids. Explains the visual aids in the presentation.
	Communication	Presentation is dull. Audience is confused and uncommunicative with presenter	Presentation is mildly interesting. Audience asked questions, but some remain unanswered.	Presentation highly interesting. Audience asks questions which presenters answered effectively.
	Presentation Skills	Voice too low. No gestures, eye contact or body language to engage other students.	Voice is clear. No gestures, eye contact or body language to engage students.	Voice is clear and strong. Gestures, eye contact and body language engage students.
Cooperation		Little or no teamwork observed.	Group attempts to work collaboratively, although some members are “off task” at times, and not everyone is actively involved.	Excellent collaboration between group members, with each of them actively involved.

Material D

Self and Peer Evaluation of GIS Group Project Form

Please assess the work that you and your partners performed on this project by using the following criteria. We will consider your feedback in assigning grades. Please be as honest and fair as possible in your assessment.

5= Excellent work; was a crucial component to the group's success
4 = Very strong work; contributed significantly to the group
3 = Sufficient effort; contributed adequately to the group
2 = Insufficient effort; met minimal standards for the group
1 = Little or weak effort; was detrimental to the group

SELF Evaluation (Name: ____________________________):
_____ Participation in creating the GIS maps project
_____ Completing interview activity and analysis of the results
_____ Willingness to discuss the ideas of other classmates
_____ Cooperation with other group members
_____ Participation in providing suggestions or ideas to control population growth in Kuwait
_____ Participation in creating the Power Point presentation
_____ Participation in the oral presentation of the project
_____ Participation in post-presentation discussion

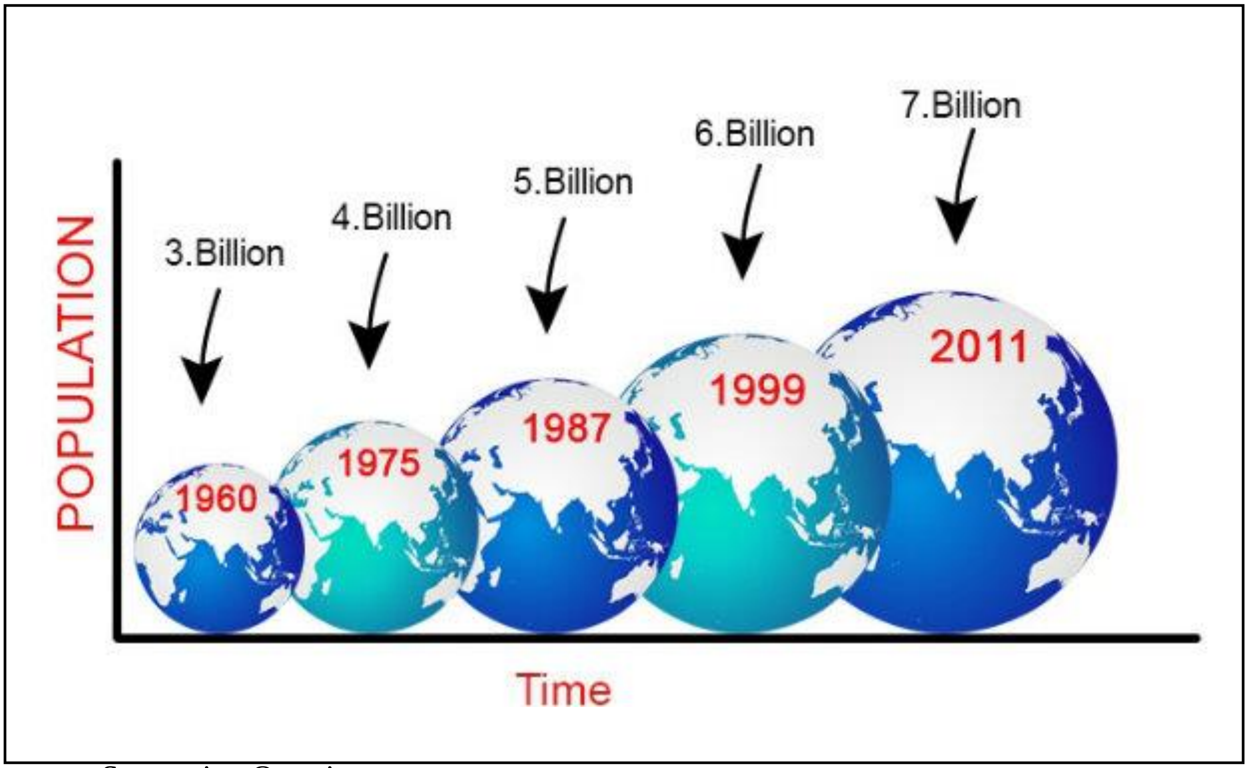
PEER Evaluation

Criteria	**Partner 1**	**Partner 2**	**Partner 3**	**Partner 4**
Participation in creating the GIS maps project				
Completing interview activity and analysis of the results				
Willingness to discuss the ideas of other classmates				
Cooperation with other group members				
Participation in providing suggestions or ideas to control population growth in Kuwait				
Participation in creating the Power Point presentation				
Participation in the oral presentation of the project				
Participation in post-presentation discussion				

APPENDIX G
ORIGINAL GIS INSTRUCTIONAL MODEL

12th Grade World Population Growth Inquiry

Is Population Growth Good or Bad for Human Development?



Supporting Questions

- How has the world's population changed over time?
- What are the causes of rapid population growth?
- What are the consequences of rapid population growth?

Table G1

GIS Instructional Model

Compelling Question		
Is population growth good or bad for human development?		
Supporting Question 1	**Formative Performance Task**	**Geographical Sources**
How has the world's population changed over time?	Create a Map Story (CASCADE Type) shows how the world's population has changed over time.	Two GIS Maps: **Source A:** World Population Growth Map **Source B:** Global Population Change in the 21st Century
Supporting Question 2	**Formative Performance Task**	**Geographical Sources**
What are the causes of rapid population growth?	Create a mind map that shows the causes of world population growth (Group work).	Three GIS maps: **Source A:** World Bank - Age and Population map **Source B:** Infant Mortality Rate map **Source C:** Adult literacy rate by country map
Supporting Question 3	**Formative Performance Task**	**Geographical Sources**
What are the consequences of rapid population growth?	Create a map journal that shows the consequences of rapid population growth in the world.	Four GIS maps: **Source A:** Tree Cover Loss map **Source B:** World Population Density map **Source C:** Unemployment Rate map **Source E:** Gross national income by country map
Summative Performance Task: Argumentative Essay Is population growth good or bad for human development? Construct an argument that discusses both viewpoints by using the story map application.		
Take Informed Action: Project-based GIS **Understand:** Create a GIS map that shows how the population has changed in Kuwait, and the effects, and causes of this population growth **Assess**: Create an action plan to solve the problems that have resulted from Kuwaiti population growth.		

Action: Write an email to a policymaker to propose changes to the highly populated governorates to accommodate future growth

Inquiry Description

This inquiry leads students through an investigation of rapid global population growth, and the planet's ability to sustain it. It should help students to think like a demographer for ways to manage the rate of this change. The question "Is population growth good or bad for human development?" opens the argument, and invites students to determine both the positive and negative aspects of population growth. Their answers to this question may vary due to several factors, such as which country is under scrutiny, what its population growth rate is, and even a student's own cultural backgrounds and beliefs. Some may see population growth as being good for business and economic development. Others might be more concerned with the associated environmental problems and limited available resources. The arguments between these differing perspectives will provide students with the knowledge and insight to evaluate either side of the debate. By investigating this inquiry, students should be able to make decision about future global population growth.

Students will learn the trends in global population growth, analyze their causes and consequences, and explore how they affect their own nation. As part of learning about population growth, students must engage in various activities such as creating story maps, drawing mind maps about population growth topics, and then follow a logical process to support their claims by working with GIS to gather evidence and link their findings to the debate. The summative performance task asks students to synthesize what they have learned from previous tasks to construct their own arguments and support them with evidence. Additionally, the search for answers will also open class discussion, and allow students to share their perspectives.

It is important to note that this inquiry will require students to build their own understanding of population growth, so teachers must think about how it will help them to construct this knowledge. In this inquiry, students will learn about the meaning of population growth and which countries have the largest and smallest numbers of people. In the second formative performance task, students will learn about the causes of population growth. In the third task, students will analyze the consequences of overpopulation. Through completing these tasks, students will have built up knowledge about population growth so they may then write an argumentative essay on the subject. In addition to the above tasks, teachers should consider how best to prepare their students for the real world beyond the school's walls. The inquiry must therefore raise student awareness about global issues and encourage them to anticipate addressing these problems, and others like them, as they assume their responsibilities as citizens of the world.

The inquiry is designed to align with AIW criteria and social constructivism as described in following section. This inquiry is expected to take six to eight 45-minute class periods to complete. This may be expanded if a teacher feels that their students need more time to complete the supporting questions. Teachers should also feel free to modify the model to meet their learning objectives.

Content, Practices, and Literacies

In addressing the compelling question “Is population growth good or bad for human development?” students will engage in a series of supporting questions, formative performance tasks, and featured sources to construct an argumentative essay with evidence from their previous GIS activities work.

The supporting questions and formative tasks introduce students to documents concerning how population growth has changed, the causes behind it, and how they affect the world. Each supporting question has a formative performance task that explains the activities that students must complete to answer the supporting question. These formative performance tasks will engage students heavily with Online ArcGIS to answer the supporting questions. GIS software has a powerful ability to allow students to investigate phenomena from a spatial perspective. Students could know the geographic location under investigation, and how that region’s particular characteristics will influence the local population’s lives, and perhaps even those further afield. Simply put, Online ArcGIS provides students with a foundation for geographic thinking by enabling them to study the relationship between phenomena and space, and how that relationship can affect humanity on a micro, or even a macroscopic scale.

Throughout the inquiry, students are asked to complete three formative performance tasks to develop their knowledge and skills to answer the supporting questions. At first, students are asked to create a story map (CASCADE) to explain how world population has changed over time. The second task asks students to create a mind map about the causes of population growth. In the third task, students will create a journal map that shows the consequences of overpopulation. In these tasks, students will gather information, then organize their thoughts using evidence and geographical reasoning to support their work. Finally, in the summative performance task, students will write an argumentative essay that explains the varying perspectives concerning the effects of population growth, supporting their arguments with the evidence and sources used throughout the inquiry.

The creation of supporting questions and formative tasks is based upon the underlying criteria established by the Authentic Intellectual Work framework. Supporting questions are designed to be logical, and the sequence of supporting questions should enable students to construct their knowledge about population growth in the world. The supporting questions must also be relevant to real world issues. The inquiry is intended to facilitate the construction of knowledge, collaboration between students, and the development of communication skills. The formative performance tasks must also consider real world issues and be relevant to students' lives. In summary, using the tenets of Authentic Intellectual Work and social constructivism theory to guide the creation of our GIS model, we will maximize the benefits of using GIS in social studies classrooms.

Explanation of Model Components

This section provide detailed description of model components that shown in table G1. It discusses for major components (1) compelling question, (2) three supporting questions with formative performance tasks and sources, (3) summative performance task, and (4) take informed action. Each component is described for social studies teachers, and how could they implement it in classroom in the following section.

1.Staging the Compelling question. The staging of the compelling question is an introductory activity that introduces students to the model's compelling question: "Is population growth good or bad for human development?" Table G2 show brief description of compelling question in this model.

Table G2

Staging Compelling Question Description

Compelling Question	Is population growth good or bad for human development?
Lesson Overview	This lesson will use images and charts to introduce students to the compelling question: "Is population growth good or bad for human development?"
Learning Objectives	- Students will gain general insight about population growth topic - Students will compare the population growth in their country in the past and present (temporal change) - Students will compare between population growth in Kuwait and Japan and how population growth differ from one country to another (spatial change).
Materials	Images and charts about population growth topic

The Compelling Question "Is population growth good or bad for human development?" asks students to deal with the unpredictability of population growth. To help students prepare for the inquiry, it is important to have them start thinking about the concept of population growth. To do this, you will ask students to view images relating to Kuwait as a way of enhancing their curiosity about how their country is changing (all images and charts are in materials section after this activity). A teacher might start with the first image depicting a line graph that illustrates population growth from 1950 to 2094. The teacher could then ask students to record three or four details about the information they see in the graph. Students may think about how significantly Kuwait's population has increased, and how it is likely to grow in the future. The teacher may also want students to consider why Kuwait's population decreased slightly following 1990 (after the Gulf War). Throughout this process, the teacher should be guiding students towards a better understanding for the concept of population growth, so that after students share their notes in class, the teacher can then ask them, "What is the meaning of population growth?"

From these initial understandings, you should then show the second image (Kuwait city in the 1960s) followed by the third image (Kuwait city today). The teacher could ask students to compare these two pictures and think about why Kuwait City has changed, and how population levels might have affected this change. A teacher may ask students to think about their personal experiences in highly populated areas. The teacher could ask students “Have you visited densely populated areas in Kuwait before, and if so, where were you, and what did you see?” Students may talk about problems they saw, such as heavy traffic, crowding, pollution, parking, etc. This should help elucidate the effects of high population growth upon Kuwait. While describing the situation in Kuwait, teachers should also note that not all countries in the world have the same population growth rates. Teachers can prove this in the fourth image which depicts a line graph describing population growth in Japan, and then ask students to interpret its meaning and take notes. Students could then compare the differences in population growth between Kuwait and Japan. They will learn that some countries, such as Japan, have low population growth rates. The teacher could ask students to think about the consequences of low population growth. Then, the teacher should move to the compelling question by asking students “Is population growth good or bad for human development?” The goal of this activity should not require students to answer this question definitively, but rather to understand that not all countries have the same population growth rates, and as a result, the answer will not always be clear. Teachers should then engage students in discussion, and offer them the opportunity to debate the merits of their arguments.

There are two goals in this exercise. The first objective is to create a foundation of knowledge that provides students with basic information about the concept of population growth. After completing this exercise students will be able to understand what population growth means. Secondly this exercise should help students to understand that population growth is temporally and spatially different across the world. For example, students will recognize that population growth rates were different in the past in comparison to today, and will also vary in the future. They will also know that population growth rates differ from one country to another, and that each country has different experiences.

Staging Compelling Question	
Materials	Image bank: photographs about population growth in Kuwait

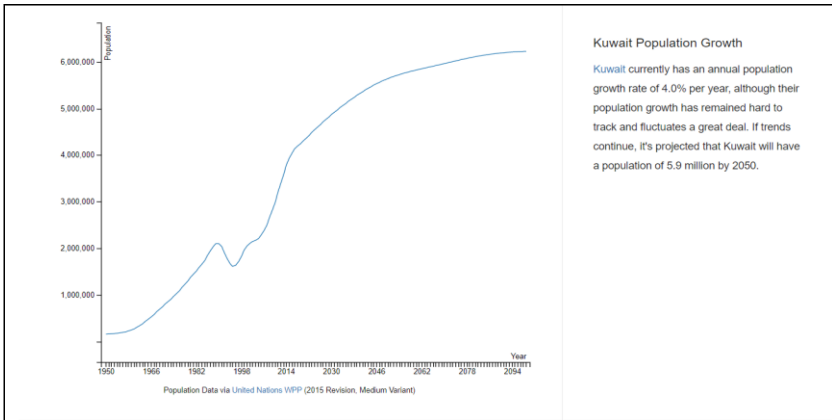


Image 1: Population growth in Kuwait from 1950 to 2094
Copyright © Worldpopulationreview.com

Kuwait in 1960s	Kuwait now
 Image 2: Kuwait City in 1960s Copyright © Aljarida Newspaper	 Image 3: Kuwait City in 2010s Copyright © Aljarida Newspaper

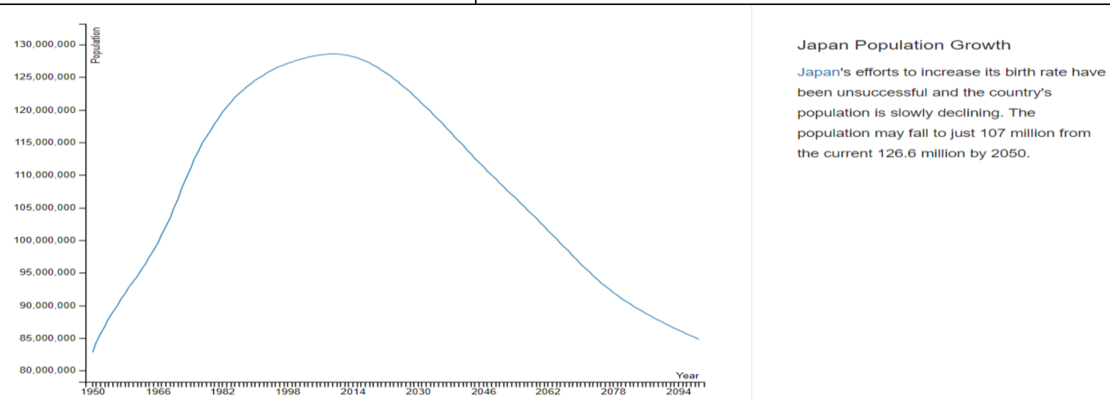


Image 4: Population Growth in Japan from 1950-2094
Copyright © Worldpopulationreview.com

2. Supporting questions, formative performance task and featured sources

This section contains three supporting questions with formative performance tasks and sources to build student knowledge about the population growth topic. Students will learn the definition(s) for population growth, as well as the changes, causes, and consequences of this change. Each supporting question is described with a formative performance task and sources.

Supporting Question #1, Formative Performance Task, and Featured Sources. This supporting question engages students to work with GIS to discover the spatial and temporal changes of population growth in the world. Teachers will use two GIS maps (featured sources) to enable students to answer this question. The table G3 below provides a brief description of what is involved with Supporting Question #1.

Table G3

Supporting Question #1 Description

Supporting Question #1	How has world population changed over time?
Formative Performance Task	Using information derived from GIS Maps, Create a Map Story (CASCADE Type) shows how the world's population has changed over time.
Featured Sources	**Source 1:** World Population Growth Map **Source 2:** Global Population Change in the 21st Century Map
Learning Objectives	Students will be able to use GIS tools such as configure pop-up, analysis, map journal, etc. to: - Explore world population changes both spatially and temporally. - Understand how population growth has changed temporally and spatially.
Social Studies Practices	Map Reading, Critical Thinking, Graphing, Using Evidence
GIS Skills	• Read map table and legend • Use configure pop-up tool to create a bar chart • Create a Story Map (CASCADE)

Supporting Question #1. This Supporting Question focuses upon providing your students with an overview for how the world's population has shifted over time. To understand this question, students will use GIS to learn about the concept of population growth, and also global population growth trends. Students will acquire the essential GIS skills to explore how the population has changed from the past to the present day, and how it is predicted to change in the future. Some of these skills will include students being able to find and add data, read GIS maps, create bar charts, use analysis tools, and create a story map to help them understand the Supporting Question.

Formative performance task for supporting question #1. The formative performance task for Supporting Question #1 calls on students to complete five GIS activities to create a map journal describing how world population has changed over time. The activities are designed to follow the geographic inquiry steps (1) Ask, (2) Acquire, (3) Explore, (4) Analyze, and (5) Act. Figure G1 illustrates the formative performance task activities to answer the supporting question #1. Table G4 illustrates how students will engage in Formative Performance Task #1 activities to answer the supporting question.

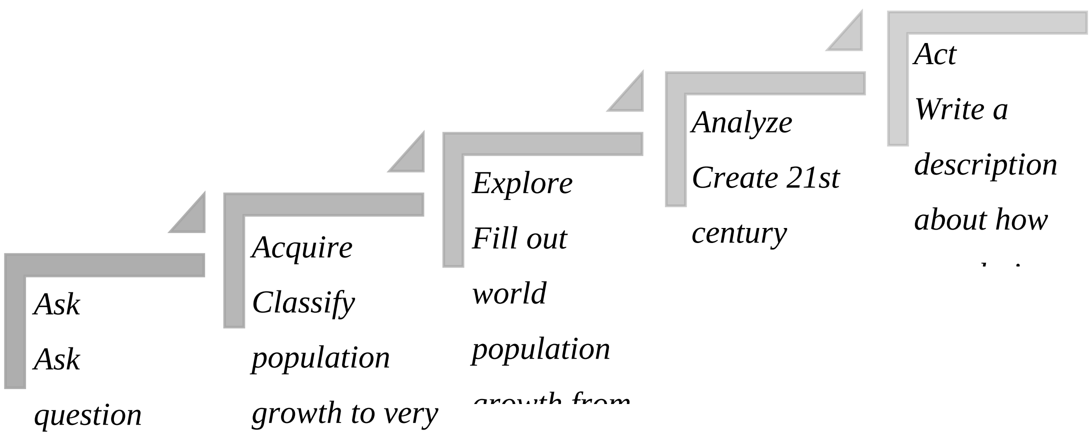


Figure G1. Formative performance task #1 activities.

Table G4

Formative Performance Task #1 Activities

Inquiry Steps	Question	Activity	GIS skills
Ask	What questions do you have about the World Population Growth Map?	Students will explore the GIS map "World Population Growth from 1960-2010"	*Find and add data *Read multi-layer map
Acquire	Classify the population growth data for 2010 as very high growth, high growth, low growth, and very low growth.	Students will read the map table and legend to show population growth details for each country.	*Show Map Table *Show Map Legend
Explore	Compare global population data from 1960 and 2010. How has the world's population changed?	Students will use the map's timeline to change years, and click on countries to show population growth details.	*Read map details *Use map timeline
Analyze	Analyze population data from 2015 and 2050. How is the population expected to change in the future?	Students will add a future population growth map, and convert population growth rates into a bar chart.	*Find and add data *Use configure pop-up tool to create bar chart
Act	How has world population growth changed?	Students will create a Story Map CASACADE type to answer Supporting Question #1	*Create Story Map CASACADE

To engage students with these activities, teacher will ask students to login to their ArcGIS Online accounts. Students will employ ArcGIS Online maps to complete five activities (Ask, Acquire, Explore, Analyze, and Act) and construct their knowledge in pursuance of answering Supporting Question #1. Students will work with their partner to complete all activities except for the last one. The last activity (Act) asks students to work in a small group to create their own story map CASCADE that demonstrates their understanding for Supporting Question #1. The following section describes these five activities:

Activity 1: Ask. The purpose of this activity is to ask students to work with their partner to explore the GIS "World Population Growth" map and formulate their own questions about it. In this activity, students will find, then add the GIS "World Population Growth" map. This document is a dynamic, GIS web map which allows students to discover the spatial and temporal patterns of population growth from 1960 through 2010. Students will examine this map in conversation with their partner, and write down relevant notes and questions about what they see. This activity enables students to gain background information about how the world's population is distributed, and how it has changed over time. As a teacher, you should clarify for your students exactly why you want them to formulate their questions. As part of this effort, you could ask them, "What questions do you have? What are you interested in?" Then have them share these ideas with their partner to gain understanding for other perspectives and generate collaborative thinking. This will help you to motivate student curiosity about the world population topic. The following box shows an example worksheet for the first activity.

Activity (1): Ask

Ask: World Population View

Sign in to ArcGIS Online→ Add World Population Growth map→ explore the GIS map, and answer the following questions with your group:

- What do you see when you look at a world population growth map? Write down all of your ideas

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- What questions do you have about the World Population Growth Map?
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Activity 2: Acquire. This activity is designed to inform students that each country has different experiences regarding population growth. Students will learn that there are high and low population growth rate countries in the world - and everything in-between. To bring about this understanding, each student will work with their partner to explore the GIS "World Population Growth" map in greater depth; clicking on countries to show details or read attribute tables. Students will read these map details, then fill out the relevant worksheet table. The table asks students to classify countries into one of four groups: (1) very high population growth, (2) high population growth, (3) low population growth and (4) very low population growth. After completing this activity, students will be able to read GIS details, such as the attribute table and legend, to gain more information about the countries under investigation. They will also learn that population growth has changed spatially.The following box shows an example worksheet for the second activity:

Activity (2): Acquire

Acquire: World Population Growth Characteristics

Move the timeline under the map to 2010→ click on countries to show details, and independently classify the Population Growth on 2010 to very high growth, high growth, low growth, and very low growth:

World Population Growth

Very low population growth 0-1%	Low population growth 1-2%	High population growth 2-3%	Very high population growth +3%

Activity 3: Explore. The previous activity was designed to teach students that population growth varies spatially. This activity asks students to investigate how the population growth rate changes with time. To achieve this aim, students will observe population growth rates from 1960 to 2010 in the GIS "World Population Growth" map to discover the temporal and spatial patterns of population change, and the corresponding global trends. Students will display the map's attributes table (which provides a rich description about the population growth rate for each country from 1960 to 2010) and fill out the world population growth table in the worksheet. The table asks students to enter population growth data for eight counties from 1960 to 2010. Each student pair must fill out the table and answer worksheet questions:

This activity will enable students to track how population growth changes over time. They will also be able to make comparisons between countries, contrasting data for their own country (Kuwait) with those in others such as China, India, Germany, etc. This activity helps students to understand that population growth rate varies from one nation to another, and that it also changes over time. This activity also enables students to read GIS map details and use the map timeline.The following box shows an example worksheet for the third activity:

Activity (3):

Explore: Population Growth over time

Press on "the time line" below the map to move to 1960 and independently fill out the following table:

World Population Growth from 1960 to 2010

Country	1960s	1970s	1980s	1990s	2000s	2010
China						
India						
Afghanistan						
Germany						
USA						
Kuwait						
Nigeria						
Switzerland						

Answer the following question with your groups:

Compare between world population in 1960 and 2010. How has the world's population changed?

Which countries experienced an increased population growth rate from 1960-2010?

Which countries had a decreased population growth rate from 1960-2010?

Which countries experienced only minor or no population growth rate changes from 1960-2010?

Activity 4: Analyze. This activity helps students to gain insight, analyze and make predictions concerning future world population growth. To accomplish this, students will add the GIS map 'Global Population Change in the 21st Century' to their ArcGIS Online account. This map visualizes future population by characterizing population densities with different colors. Deep red indicates high population growth countries on the map, while light red refers to those with low population growth. This map also allows students to read the attribute table, or click on a country to show actual population details from 2015 and the predicted results for 2050. In this activity, students will convert numerical data into a bar chart yielding a visual representation of these data. This bar chart will depict the population growth in 2015 and also in 2050, enabling students to compare between these two years easily. This exercise will enable students to understand how to use GIS to convert data from a numerical format into its visual representation, making it easier to interpret its deeper meaning. It will also help students to understand how population growth will change in the future. The following box shows an example worksheet for the fourth activity:

Activity (4):

Analyze: The Trends of World Population Growth in the Future

Add a world population projection layer→ convert the population data to a bar chart, and discuss the following questions with your group:

Compare between populations in 2015 and 2050. How will the population change in the future?

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List the five most populated and lowest populated countries in the future (2050).

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What is the most highly populated continent in the future?

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What is the least populated continent in the future?

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Activity 5: Act. For the final activity, each group creates a story map (CASCADE Type) about how world population has changed over time. They will support this document with evidence (numbers, examples, and maps) derived from their efforts in the previous activities. Each group will then make a presentation of their work and receive comments about the merits of their arguments from their teacher and classmates. The following box shows an example worksheet for the final activity:

Activity

Act: Creating Story Map (CASCADE Type)

Create a story map (CASCADE Type) showing how the world's population has changed over time? Support your story map with data from GIS maps, images, and numbers.

Your work must have:

Write an introduction about the concept of population growth.

List at least three examples of very low, low, high, very highly populated countries with add description.

Explain how population growth changed from 1960 to 2010 with examples.

Describe the population growth in the future with examples.

Consider the following notes:

Use description text.

Mention numbers and locations on the map.

Using images and graphs, explain your ideas. You can Google for images or graphs.

In this activity, students must work collaboratively to create their own story map. They should use their prior knowledge about population growth from previous activities to construct their story map, aided by guidelines and instructions from their teachers. This activity will help clarify a student's ideas. Its completion should enable teachers to ensure that their students understand the supporting question. However, the teacher will use a rubric to assess a student's understanding and help them to improve their work. Table G5 represents the rubric that teachers can use to assess students work. Students will use the rubric to learn what is expected of them while they work on their story map, especially the level of detail which they need to provide, and this should help them improve their efforts. The following criteria and rubric can be used to determine the quality of a student's story map.

Table G5

Supporting Question #1 Rubric

	Below Standard	Adequately Meets Standard	Exceeds Standard	Exemplary
Organization	Confusing, and many ideas and concepts are missing	Somewhat organized, contains a few of ideas and concepts related to supporting question.	Thoughtfully organized, and contains most of ideas and concepts related to supporting question.	Well organized, and contains all concepts and ideas related to supporting question.
Use of color/ GIS maps/ images/ graphs	Students use little color without using images, GIS maps and graphs to illustrate connections with ideas.	Students use obvious color with images to illustrate some ideas.	Students use effective color with in GIS maps and images to illustrate most of their ideas.	Students use multiple colors with images, GIS maps, and graph to illustrate all their ideas.
Content	Bare minimum of content covered without evidence or examples	Show basic ideas with few of examples or evidence	Show a solid understanding of most content using examples and evidence	Show a solid understanding of all content using examples and evidence
Cooperation	Little or no teamwork is noted	Attempt to work collaboratively but some students were “off task” sometimes and not everyone actively involved	Work well collaboratively and students are actively involved	Work extremely well collaboratively. Students share and respect ideas.

Facilitating AIW through Formative Performance Task #1 activities. Through your instruction of these activities, as a social studies teacher, you must work on facilitating AIW criteria. The sequence of geographic inquiry activities will help students to construct their knowledge about this subject so that they can then answer the supporting question about “*how population growth has changed over time”*. It is important to encourage your students to work collaboratively in these activities to help them build shared knowledge through the exchange of information with their peers. As a teacher, you must activate these discussions and conversation between students to provide them with the opportunity of discovering multiple perspectives.

Moreover, students must construct their knowledge by employing critical thinking skills. For example, you should ask students to compare, contrast, and analyze information on the map to understand how population growth has changed over time and space. There are five activities which students must complete to build their knowledge, and these follow the geographic inquiry steps: (a) ask; (b) acquire; (c) explore; (d) analyze; and (e) act.

And finally, meaningful intellectual accomplishments must have value beyond school. Through teaching this task, you may prompt students to discover their country more fully and make connections with other parts of the world. You may also ask them to describe their own personal experiences and opinions regarding changes in population growth.

Featured sources of supporting question #1. Students need to use featured sources to complete the formative performance task activities that enable them to answer supporting question #1. Thus, teachers will ask students to work with two GIS maps to complete GIS activities and answer the supporting question:

1. World Population Growth GIS Map (Carto, 2016). It is an ArcGIS Online map of world population growth from 1960 to 2010. The World Population Growth map is a dynamic, web GIS map which allows students to discover the spatial and temporal patterns of population growth from 1960 through 2010 (see Figure G2).

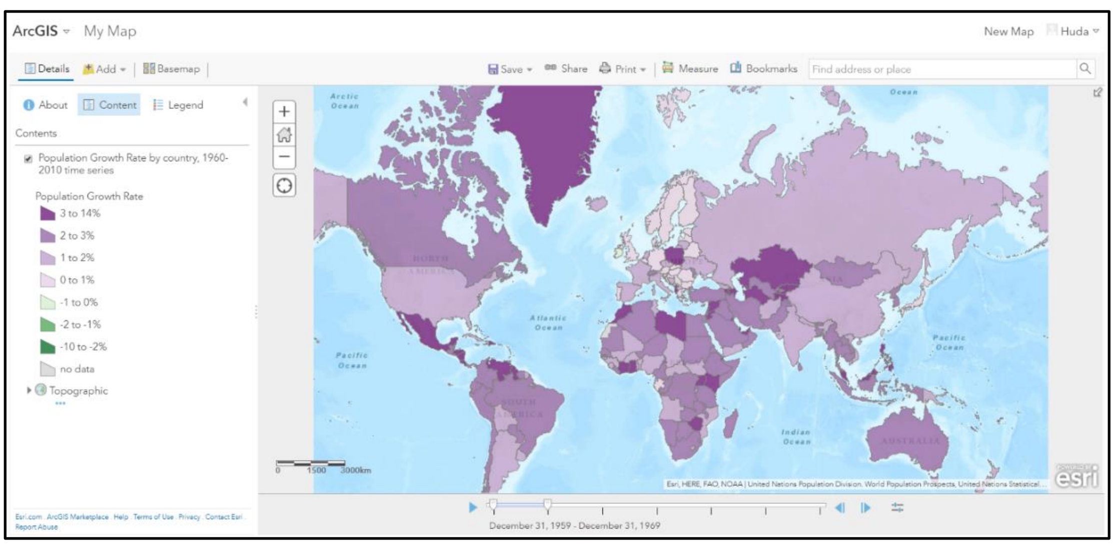

Figure G2. World population growth ArcGIS Online map hosted by ESRI.

2. Global Population Change in the 21st Century GIS Map (Walker, 2015). It is ArcGIS Online map which predicts future world population. It also provides a little data about the total population for three different years - 2012, 2015, and 2050. This should enable the reader to compare the known population details from 2012 and/or 2015 with the predicted data for 2050 (see Figure G3)

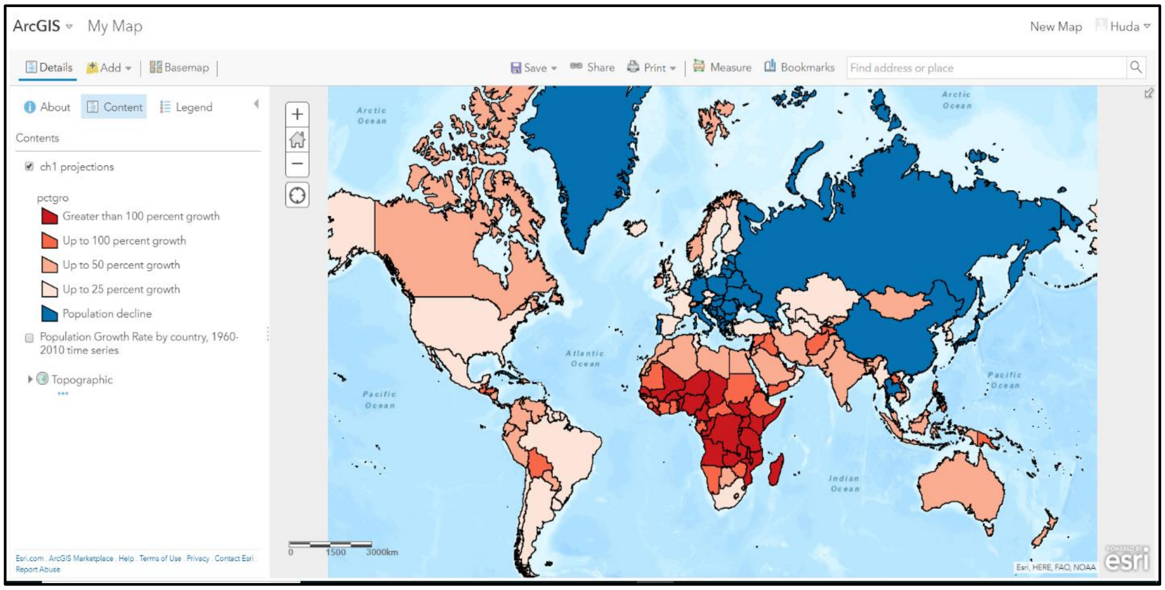

Figure G3. Global population in the 21st century ArcGIS Online map hosted by ESRI

Supporting Question #2, Formative Performance Task, and Featured Sources. This Supporting Question engages students to work with GIS to investigate the causes of population growth in the world. The Formative Performance Task asks students to complete several GIS activities to answer Supporting Question #2. Teachers will use two GIS maps to complete the activities in this task (Featured Sources). A brief description of the supporting question #2 is presented in the table G6 below.

Table G6

Supporting Question #2 Description

Supporting Question	What are the causes of rapid population growth?
Formative Performance Task	Create a mind map that shows the causes of world population growth (Group work).
Featured Sources	**Source A:** World Bank - Age and Population map **Source B:** Infant Mortality Rate map **Source C:** Adult literacy rate by country map
Learning Objectives	- Students will learn the causes of rapid population growth. - Students will compare between high and low populated countries.
Social Studies Practices	Critical thinking, graphing, map reading, using evidence
GIS Skills	- Find and add data - Symbology feature - Configure pop-up

Supporting Question #2. This supporting question focuses upon providing your students with information about the causes of global population growth. This inquiry is connected with the previous supporting question and those which follow. In Supporting Question #1, students gained a foundation of knowledge for how the world's population has changed. They should have concluded that it has increased rapidly overall, but has differed from country to country. In this supporting question, students must work with GIS to explore the reasons behind these changes. They will use GIS to discover four primary factors are: (a) natural rate of increase, (b) fertility rate, (c) infant mortality rate and (d) life expectancy.

Formative performance task for supporting question #2. The Formative Performance Task for Supporting Question #2 calls for students to complete five GIS activities. You will ask students to engage in classroom activities which comply with the five steps of geographic inquiry: (1) Ask, (2) Acquire, (3) Explore, (4) Analyze, and (5) Act. Figure G4 illustrates the formative performance task activities to answer the supporting question #2. Table G7 illustrates how students will engage in Formative Performance Task #2 activities to answer the supporting question.

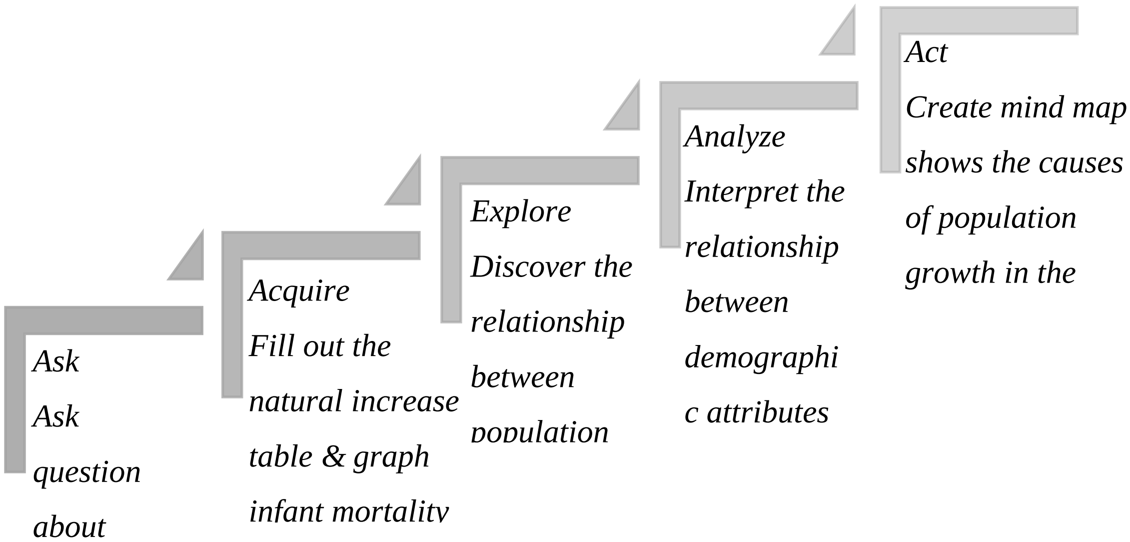

Figure G4. Formative performance task #2 activities

Table G7

Formative Performance Task #2 Activities

Inquiry Steps	Question	Activity	GIS Skills
Ask	What questions do you have about the "Natural Increase" map?	Students will explore the "Natural Increase" GIS map.	*Find and Add data *Read a multi-layer map
Acquire	Which are the countries with high natural increase, fertility, life expectancy, and infant mortality rates? Which are the countries with low natural increase, fertility, life expectancy, and infant mortality rates?	Students will read the map table, timeline, and legend to show the natural increase, fertility, and life expectancy rate details for countries. They will also use the configure pop-up tool to convert infant mortality rate to bar chart.	*Show map table *Show timeline *Show map legend *Configure pop-up
Explore	What is the relationship between population growth and natural increase, fertility, and life expectancy rates? Support your answer with examples What are the causes of high fertility and low expectancy?	Students will compare between the population growth layer and natural increase, fertility, and life expectancy rate layers.	*Read map details
Analyze	What are the identifying characteristics of high, low, and zero population growth rate countries? What did you learn about the zero population growth rate country?	Students will add literacy rate GIS map, and read the information in the map. Students will fill the literacy rate in high and low population growth countries, and discuss their notes with pair.	*Find and add data *Read GIS map
Act	What are the causes of world population growth?	Students will add new slides to their story map journal to answer Supporting Question 2	*Adding slides to their story map journal

To hook your students into these activities, teacher will ask students to access their ArcGIS Online accounts to complete the activities and answer all questions. Students will work with a partner to complete all activities except the final one. For this last activity (Act), teacher will ask students to work in a small group to create their mind map which demonstrate their understanding for Supporting Question #2. The following sections describe the five activities students must complete:

Activity 1: Ask. This activity introduces students to the 'natural increase' topic as a major reason behind population growth. To complete this task, each student pair will find, then add the "World Bank-Age and Population" GIS map to their journal. This document is a multi-layer GIS map that contains information about birth, death and fertility rates. Students will examine this map, reviewing its layers, and then respond to the following question: *"What questions do you have?"* This activity encourages student-generated questions to help them demonstrate their understanding for the topic being covered. The following box shows an example worksheet for the first activity:

Activity (1):

Ask: Natural Increase Rate

Open ArcGIS Online and add the following layer: World Bank: Age and Population Map→ Move to 2010→turn off all layers except birth rate, death rate, births per woman, annual population growth maps:

- What questions do you have? write them down

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Activity 2: Acquire. In the second activity, the teacher focuses on students acquiring basic population growth concepts such as natural increase, fertility, and infant mortality. Students will engage with GIS maps to complete the second activity in the worksheet. The second activity has two main exercises. In the first exercise, students will review population and age map data to learn and record the birth, death, fertility, and life expectancy rates for eight countries: Germany, USA, Kuwait, Afghanistan, India, Switzerland, China and Egypt. The second exercise involves students converting infant mortality rate data from 2000 to 2015 into a bar chart by employing GIS tools. Using the data learned from the two exercises, students will record relevant details and ideas, and share these findings with their pair. The following box shows an example worksheet for the second activity :

Activity (2):

Acquire: Basic Population Growth Concepts

Natural Increase, Life Expectancy & Fertility Rate

Country	Annual Births per 1000	Annual deaths per 1000	Total Births per woman	Life Expectancy
Germany				
US				
Kuwait				
Afghanistan				
India				
Switzerland				
China				
Egypt				

Look at the World Bank- Age and Population Map and fill out the following table:

- What are the high Natural Increase Rate countries?
- What are the low Natural Increase Rate countries?
- What are the high fertility rate (number of births per woman) countries?
- What are the high life expectancy countries
- Add an Infant Mortality layer and convert the infant mortality rate to a bar chart, and answer the following questions with your group:
- What do you note/observe? Why?

Activity 3: Explore. In the third activity, the teacher asks students to explore the relationships between population growth, life expectancy and birth, and fertility rates. Students will take advantage of GIS tools to visually translate multiple layers of data. This will enable students to more readily discover the relationships between variables governing growth in countries with high or low populations. Students will work with pair in this activity, and they will answer the worksheet questions. The following box shows the example of the third activity in the worksheet:

Activity (2):

Explore: The Relationship between Population Growth and Basic Population Concepts

In the World Bank - Age and Population Map→ turn off all layers except the population growth, and Births per 1000 people layers, then compare between the population growth map and birth rate:

- What are the relationship between population growth and birth rate? Support your answer with examples.

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Turn off all layers except the population growth and fertility rate layers. Compare between population growth and fertility rate layers:

What is the relationship between population growth and fertility rate? Support your answer with examples.

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Turn off all layers except the population growth and Life expectancy layers. Compare between population growth and Life expectancy rate layers:

What is the relationship between population growth and life-expectancy rate? Support your answer with examples.

…………………………………………………………………………………………………
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Activity 4: Analysis. In the fourth activity, Students will add three GIS maps literacy rate map and interpret the relationship between population growth and literacy rate. In this activity, students will display the data in GIS map and fill out the table about the literacy rate in high and low population growth countries. After filling out the map, students will discuss their findings within their pair. The following box shows the example of the fourth activity in the worksheet:

Activity (2):

Analyze: Education Level & Population Growth

Add the "Adult Literacy Rate by Country Map", and fill out the following table:

Literacy Rate in High and Low Population Growth Countries

Population	Country	Literacy Rate	Your Notes
High	India		
	Egypt		
	Mexico		
	Sudan		
Low	Japan		
	France		
	Belgium		
	Germany		

What is the education level of people who live in high population growth rate countries?
………

What is the education level of people who live in low population growth rate countries?
………

Activity 5: Act. In the final activity, teachers will ask students to work in groups to create a mind map that illustrates the causes of rapid population growth around the globe. Students will use the Mindmup.com website which provides students with the opportunity to easily create a mind map for free. The mind map will help students to visualize and organize ideas and thoughts from the previous activities about the causes of population growth. Teachers must encourage students to use images, graphs and GIS maps to support the conclusions that they draw with their mind maps. The following box shows the final activity in the worksheet:

Activity

Depending on the previous GIS activities: Create a mind map that shows the causes of world population growth (Group work). Support your mind map with GIS maps, examples, images and numbers.

Teachers should observe student work and give them feedback if needed. The teacher should also encourage students to tap their creativity in drawing their map, and to have some fun in the process. Teachers must use the rubric in table G8 to help students self-assess their own work. This rubric will also help a teacher monitor student learning and hopefully improve the process for future use. Teachers should also ask students to present their mind map and review the work of their groups. It is suggested that each student group should be given five minutes to present their mind map, with a further five minutes devoted to class discussion of their efforts in which they will also receive feedback from both their teacher and peers.

Table G8

Supporting Question #2 Rubric

	Below Standard	Adequately Meets Standard	Exceeds Standard	Exemplary
Organization	Confusing, and many ideas and concepts are missing	Somewhat organized, contains a few ideas and concepts related to supporting question.	Thoughtfully organized. Contains most ideas and concepts related to supporting question.	Well organized, and contains all concepts and ideas related to supporting question.
Use of color/ GIS maps/ images/ graphs	Students use little color, without images, GIS maps or graphs to illustrate connections to ideas.	Students use obvious color with images to illustrate some ideas.	Students use effective color with GIS maps, and images to illustrate most of their ideas.	Students use multiple colors with images, GIS maps, and graphs to illustrate every idea.
Content	Mentions one reason for rapid population growth without evidence or examples	Mentions two reasons for rapid population growth with few examples or evidence	Mentions three reasons for rapid population growth using examples and evidence.	Mentions four reasons for rapid population growth using examples and abundant evidence.
Cooperation	Little or no teamwork is noted	Attempts to work collaboratively but some students “off task” sometimes. Not everyone actively involved.	Work well collaboratively, and students actively involved	Work extremely well collaboratively. Students share and respect ideas.
Presentation	Poor knowledge of subject, low ability to communicate with audience, and speaks too quietly.	Below average subject knowledge. Below average communication. Speaks quietly.	Adequate subject knowledge. Good communication. Speaks with adequate volume.	Above average subject knowledge. Excellent communication. Speaks strongly.

Facilitating AIW through Formative Performance Task #2 activities. Through instructing these activities, as a social studies teacher, you must work on facilitating AIW criteria. The sequence of geographic inquiry activities will help students to construct their knowledge about the causes of population growth. It is important to encourage your students to work collaboratively through these activities to help them build shared knowledge. Building shared knowledge will help students to discover multiple perspectives for the phenomena that they are observing and also improve their understanding for them. As a teacher, you must activate discussion and conversation between students to provide them with the opportunity to discover multiple viewpoints and opinions. Moreover, students must construct their knowledge by using critical thinking skills.

The GIS activities involved with this supporting question are more advanced than those engaged with previously. Students will build their own GIS layer rather than analyzing an existing example. Students will search, collect and insert visually representative data to understand the spatial variations between countries regarding population fertility, infant mortality, and life expectancy rates. Higher order thinking will help students deepen their understanding of the content.

And finally, meaningful activities must have value-beyond school and be related to student personal experience. Through teaching this task, students will compare multiple population growth concepts (e.g. fertility, and life expectancy rates) between their country (Kuwait), and countries around them. You may ask students to provide their opinions about these comparisons and to share these thoughts with their peers.

Featured Sources for Supporting Question #2. Students need to use featured sources to complete the formative performance task activities that enable them to answer supporting question #2. Thus, teachers will ask students to work with three GIS maps to complete GIS activities and answer the supporting question:

1. The World Bank - Age and Population GIS Map (International User Community, 2018). It is a multi-layered ArcGIS Online map that provides rich data about global birth, death, life expectancy and fertility rates between 1960 and 2012 (see Figure G5).

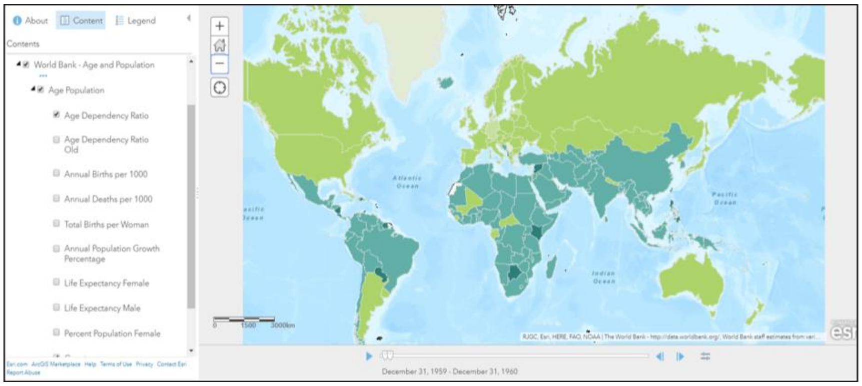

Figure G5. The World Bank - Age and population ArcGIS Online map hosted by ESRI.

2. Infant Mortality Rate (Unstats, 2017). It shows global infant mortality rates (deaths per 1,000 live births) from 2000 to 2016 (see Figure G6)

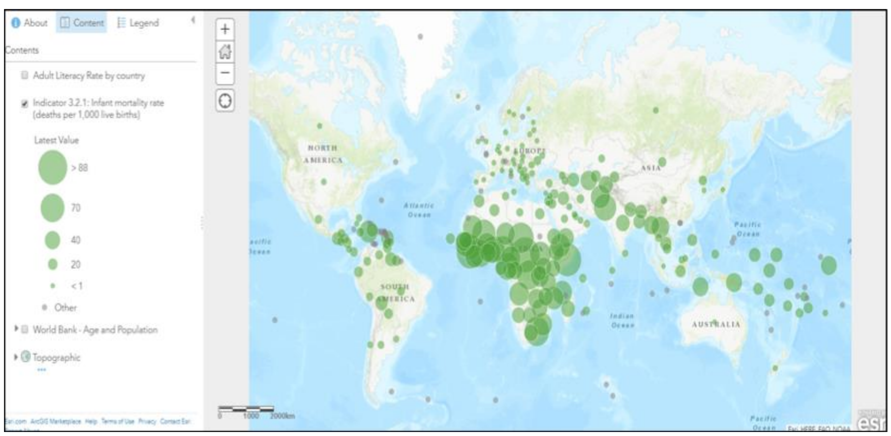

Figure G6. Infant mortality ArcGIS Online map hosted by ESRI

3. Literacy Rate GIS Map (Carto, 2016). Adult Literacy Rate by Country ArcGIS Online map provides data about the percentage of people who can read and write basic statements for daily life usually above that of a 15 years old (see Figure G7).

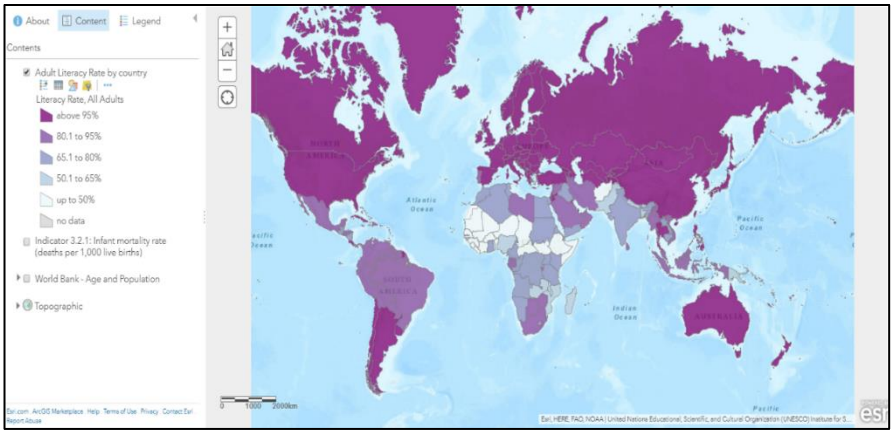

Figure G7. Adult literacy rate by country ArcGIS Online map hosted by ESRI

Supporting Question #3, Formative Performance Task, and Featured Sources. This Supporting Question asks students to work with GIS to identify the consequences of population growth in the world. The Formative Performance Task engages students to work with GIS to complete five activities to answer Supporting Question #3. Teachers will use two GIS maps to complete this task. A brief description of Support Question #3 is present in the table G9 below.

Table G9

Supporting Question #3 Description

Supporting Question 3	What are the consequences of rapid population growth?
Formative Performance Task	Create a Map Journal that shows the consequences of rapid population growth in the world.
Featured Sources	**Source A:** Tree Cover Loss map **Source B:** World Population Density map **Source C:** Unemployment Rate map **Source E:** Gross national income by country map
Learning Objectives	- Students will learn about the consequences of rapid global population growth. - Students will spatially explore the relationships between population growth and societal problems.
Social Studies Practices	Map reading, critical thinking skills, geographical reasoning, using evidence.
GIS Skills	- Find and add data - 3D imagery scene

Supporting Question #3. The previous supporting question gave your students the knowledge about the causes behind global population growth. This question will provide understanding for the *consequences* of such growth. Students will learn four damaging results: (a) deforestation, (b) environmental problems, (c) economic factor, and (d) social factor. They will use ArcGIS Online tools to explore the effects of overpopulation, and how population growth will affect people's lives and their environment.

Formative performance task for supporting question #3. The formative performance task for supporting question #3 requires students to use a GIS 3D map and analyze GIS layers to identify the causes of population growth. Then, they will create their Story Map Journal describing the consequences of global population growth. The activities were designed to follow the geographic inquiry steps (1) Ask, (2) Acquire, (3) Explore, (4) Analyze, and (5) Act as showed in figure G8. Table G10 illustrates how students will engage in Formative Performance Task #3 activities to answer the supporting question.

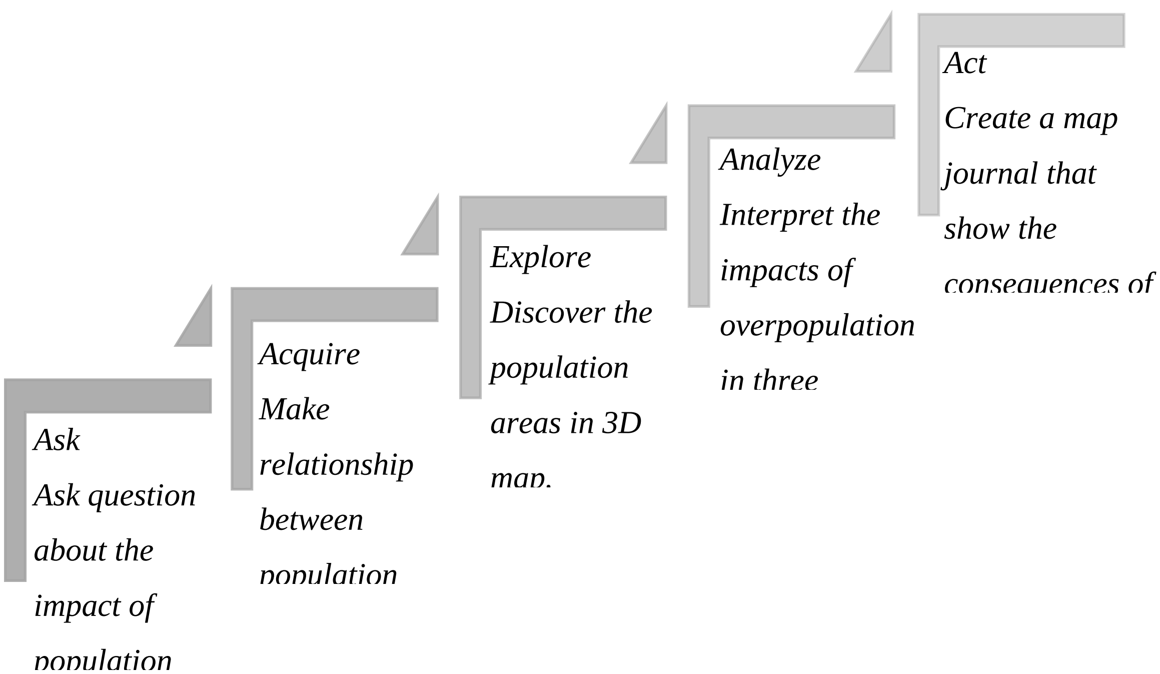

Figure G8. Formative performance task #3 activities.

Table G10

Formative Performance Task #3 Activities

Geographic Inquiry Steps	Question	Activity	GIS skills
Ask	What do you already know about the consequences of rapid population growth? What do you want to know?	Each pair will create their own questions about what they know and want to know about the consequences of population growth.	-
Acquire	Is there any relationship between population density and tree cover loss? Why?	Students will add the GIS tree cover map and density map, and examine the relationships between them.	*Find and add data.
Explore	How may population affect the environment?	Students will add a world density map to the 3D imagery scene to investigate the environment in population zones.	*Add data *3D imagery scene
Analyze	Is there a relationship between population growth and income rate? If so, describe it? Is there a relationship between population growth and unemployment? If so, describe it?	Students will add three GIS layers: (1) population growth, (2) national income rate, and (3) unemployment rate to identify the consequences of population growth. Students will make relationship between these layers to investigate the relationship between population growth and income and unemployment rates.	*Build a GIS layer *Add points *Create an attribute table *Symbology
Act	How world population growth has changed?	Students will add slides to their story map journal to answer supporting question 3	*Adding slides to a story map journal

To hook students into these activities, teacher will ask students to access their ArcGIS Online accounts and and answer all questions. Students will engage with ArcGIS Online maps to complete five main activities to construct their knowledge regarding Supporting Question #3. Students will work with a partner to complete all activities except the final one. For this last activity (Act), teacher will ask students to work in a small group to add slides to their Story Map Journal which demonstrates their understanding for Supporting Question #3. The following sections describe the five activities students must complete:

Activity 1: Ask. In the first activity, students must answer the following question: "What do you already know about the consequences of population growth, and what do you want to know"? Students will work with their partners, sharing their prior knowledge and personal experiences about the subject. This will help prompt them to think about what they want to know, stimulating their curiosity, and hopefully encouraging them to become active learners. . The following box shows the first activity in the worksheet:

Activity (1):

Ask: The Impacts of Rapid Population Growth

What do you already know about the consequences of rapid population growth? And what do you want to know? Each group creates their own questions

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……
……

Activity 2: Acquire. This activity asks students to investigate the relationships between population growth and tree cover loss. Students will explore the environmental issues in highly populated areas. To complete this task, each pair of students will add a "tree cover loss" layer to their GIS map. They will inspect the spatial distribution of global deforestation, and record their observations. Students will then add a "world population density layer" onto the "tree cover loss" layer in order to spatially analyze the relationships between areas of population and deforestation; again recording notes about their findings. The following box shows the second activity in the worksheet:

Activity (2):

Acquire: Tree Cover Loss & Population Density

Each students will open ArcGIS Online→ Add Tree Cover Loss layer→ Read layer description and, with your group, answer the following question:

What do you see?

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……………………………………………………………………………………………

Add Population Density Layer→ Read layer description, and answer the following question:

Is there any relationship between population density and tree cover loss? Why?

……
……………………………………………………………………………………………

Activity 3: Explore. This activity requires students to discover the characteristics of highly populated countries, and to learn why such countries also have high tree cover loss. Students will use the GIS 3D scene to identify areas of high population and understand what they look like. Students will add a world density map onto the 3D scene to discover what the high density areas look like. Students will observe that the highly populated areas have streets, buildings, hospitals, lights, etc. and relate how these may affect the environment. These details may indicate that countries will remove trees to build infrastructure for their people, leading to increased overall tree cover loss. Completing this activity enables students to answer the following question: *"How may population affect the environment?"* Students will investigate the connections between urbanization and global tree cover loss to answer this question.The following box shows the third activity in the worksheet:

Activity (3):

<u>Explore: World Population 3D map</u>

Each student will click on Home→ choose scene→ explore the population density by zooming into the population area, and with your group discuss the following questions:

What do you see?

………
……………………………………………………………………………………………

How may population affect the environment?

………
……………………………………………………………………………………………

Activity 4: Analyze. In the fourth activity, the teacher will ask students to analyze data in three maps to interpret the relationships between population growth rates and two variables: unemployment, and national income rate. In this activity, students will display the data in each map and fill out the unemployment and national income rates in high and low population growth countries. After filling out the map, students will discuss their findings within their group. The following box shows the fourth activity in the worksheet :

Activity (4):

Analyze: The consequences of population explosion

Add the "Unemployment Rate Map", and "Gross National Income by Country Map" layers, and fill out the following table:

National Income & Unemployment Rate for Selected Countries

Population Growth	Country	Gross National Income	Unemployment	Your Notes
High	India			
	Egypt			
	Mexico			
	Sudan			
Low	Japan			
	France			
	Belgium			
	Germany			

- Write a summary of your conclusions from the previous table?

……
……
…………………………………………………………………………………..

Activity 5: Act. In the final activity, each group will create a Map Journal using the story maps app. This application enables students to create a digital journal that shows their maps, information, and images that explain the consequences of overpopulation in the world. The teacher will ask students to use their previous work, such as their multi-layer maps, and add text that describes the consequences of global population growth. The teacher must clarify this activity to students by giving them the requirements and instructions to make sure they understand what to do. The following box shows the final activity in the worksheet:

Activity (5):

Each group will create a Map Journal that shows the consequences of global overpopulation by using the ArcGIS Online story map option. The Map Journal should be supported by:

- GIS maps, images, and graphs.
- Using Google Scholar to add a line graph about world population growth. Then explain the line graph.
- Mention reasons for population growth (from last lesson).
- Explain important consequences (of overpopulation) with examples, maps, and images.

The teacher could use the rubric in table G11 to enable students to assess their own work. This will help them see how their efforts compare to an acceptable standard, and therefore motivate them to revise and improve to meet that high standard. For example, the Map Journal should provide evidence that students understand the supporting questions. Then, the teacher could use a rubric that measures student understanding of the supporting question

Table G11

Supporting Question #3 Rubric

	Below Standard	**Adequately Meets Standard**	**Exceeds Standard**	**Exemplary**
Organization	Confusing, and many ideas and concepts are missing	Somewhat organized. Contains a few ideas and concepts related to supporting question.	Thoughtfully organized. Contains most ideas and concepts related to supporting question.	Well organized. Contains all concepts and ideas related to supporting question.
Use of color/ GIS maps/ images/ graphs	Students use little color, without images, GIS maps and graphs to illustrate connections to ideas.	Students use obvious color and images to illustrate some ideas.	Students use effective color while using GIS maps and images to illustrate most of their ideas.	Students use multiple colors, with images, GIS maps, and graphs to illustrate all of their ideas.
Population Growth Line Graph	No use of population growth line graph.	Use population growth line graph without explanation.	Use population growth line graph with clear explanation.	Use population growth line graph with detailed explanation.
Content	Mentions one consequence of overpopulation, but without evidence or examples	Mentions two consequences of overpopulation, but with few examples or evidence	Mentions three consequences of overpopulation while using examples and evidence.	Mentions four or more consequences of overpopulation while using examples and abundant evidence.
Make connection	Fails to make a connection between reasons and consequences	Makes incorrect connections	Clearly makes connection between reasons and results of overpopulation.	Effectively makes connections between reasons and results of overpopulation.
Cooperation	Little or no teamwork is noted	Attempts to work collaboratively but some students were “off task” sometimes. Not everyone is actively involved.	Works well collaboratively and students are actively involved	Work extremely well collaboratively, and students share and respect ideas.
Presentation	Poor subject knowledge. Poor communication with audience, and speaks too quietly.	Below average subject knowledge. Below average communication, and speaks quietly	Adequate subject knowledge. Good communication, and speaks with adequate volume.	Above average subject knowledge. Very good communication, and speaks strongly.

Facilitating AIW through Formative Performance Task #3 activities. Through instructing these activities, as a social studies teacher, you must work on facilitating AIW criteria. The sequence of geographic inquiry activities will help students to construct their knowledge about the consequences of population growth. It is important to encourage your students to work collaboratively through these activities to help them build shared knowledge. Building shared knowledge will help students to discover multiple perspectives for the phenomena that they are observing and also deepen their understanding for them. As a teacher, you must activate discussion and conversation between students to provide them with the opportunity to discover multiple viewpoints and opinions. Moreover, students must construct their knowledge by using critical thinking skills.

The GIS activities involved with this supporting question are more advanced than those engaged with previously. Students will use 3D imagery and attach this layer with a density map to explore the characteristics of high and low population areas. Using critical thinking skills, through their working with GIS, will help students to understand the consequences of population growth from a spatial perspective.

And finally, meaningful activities must have value-beyond school and relate to student personal experiences. Through teaching this task, students will gain understanding for the consequences of population growth in the world. You may ask students to provide their opinions about these consequences (as they are part of the world,) and to share these thoughts with their peers.

Featured Sources of Supporting Question #3. Students need to use featured sources to complete the formative performance task activities that enable them to answer supporting question #3. Thus, teachers will ask students to work with four GIS maps to complete GIS activities and answer the supporting question:

1. Tree Cover Loss GIS Map (Global Forest Watch, 2015). It provides information about global tree cover loss (see Figure G9)

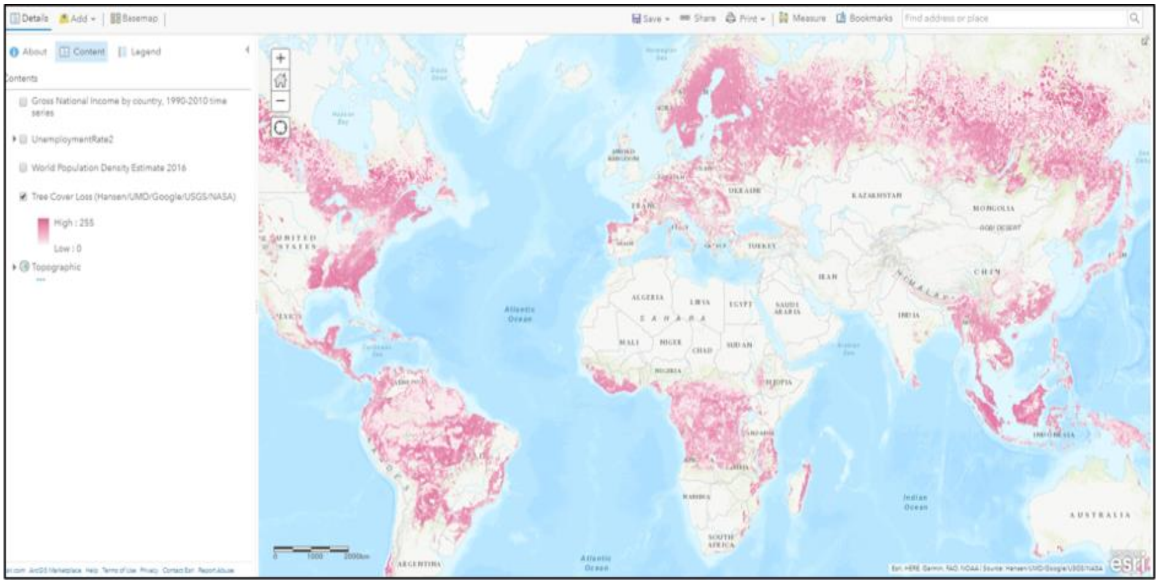


Figure G9. Tree cover loss ArcGIS Online map hosted by ESRI

2. World Population Density GIS Map (ESRI, 2017). It provides an estimate of population density in persons-per-square-kilometer for people living within the area represented by the cell (see Figure G10).

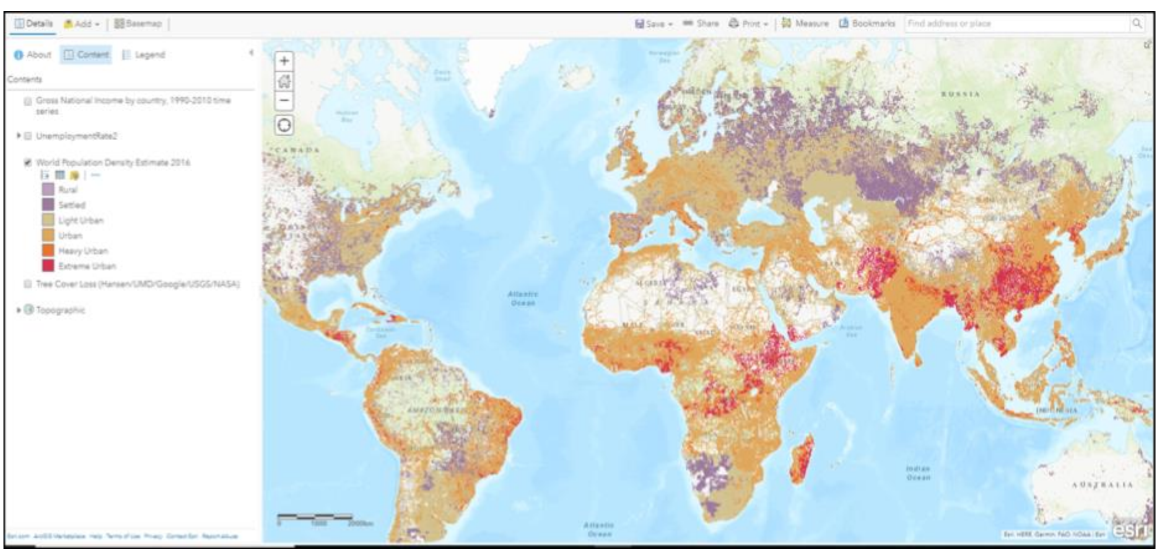


Figure G10. World population density ArcGIS Online map hosted by ESRI

3. Unemployment Rate GIS Map (Bell, 2016). This ArcGIS online map shows the unemployment rate by male and female at the country level (see Figure G11).

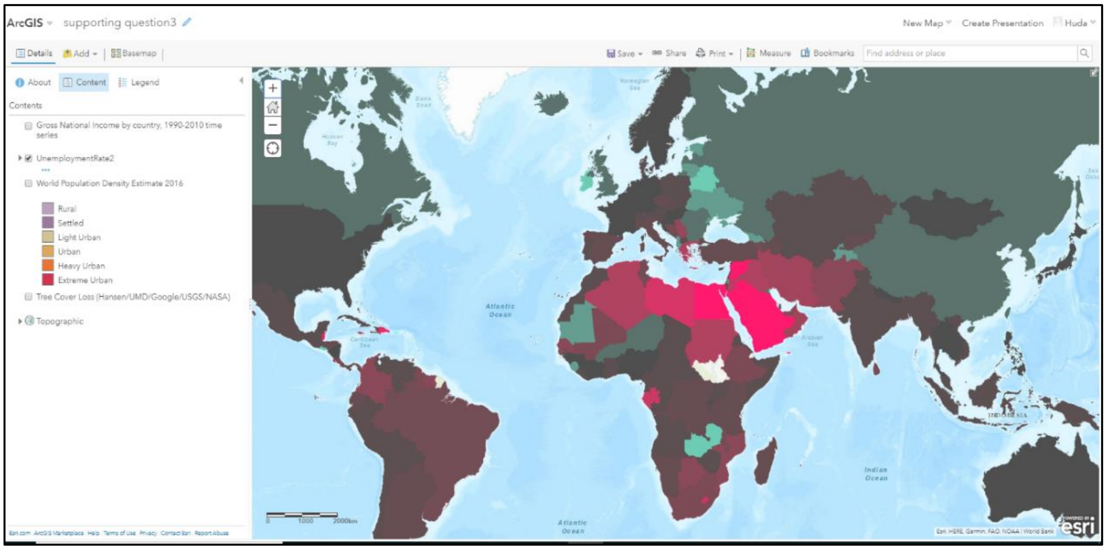


Figure G11. Unemployment rate ArcGIS Online map hosted by ESRI

4. National Income Rate GIS Map (Carto, 2016) ArcGIS online map provides information about purchasing power parity (current international $) by country, from 1990 to 2010 (see Figure G12).

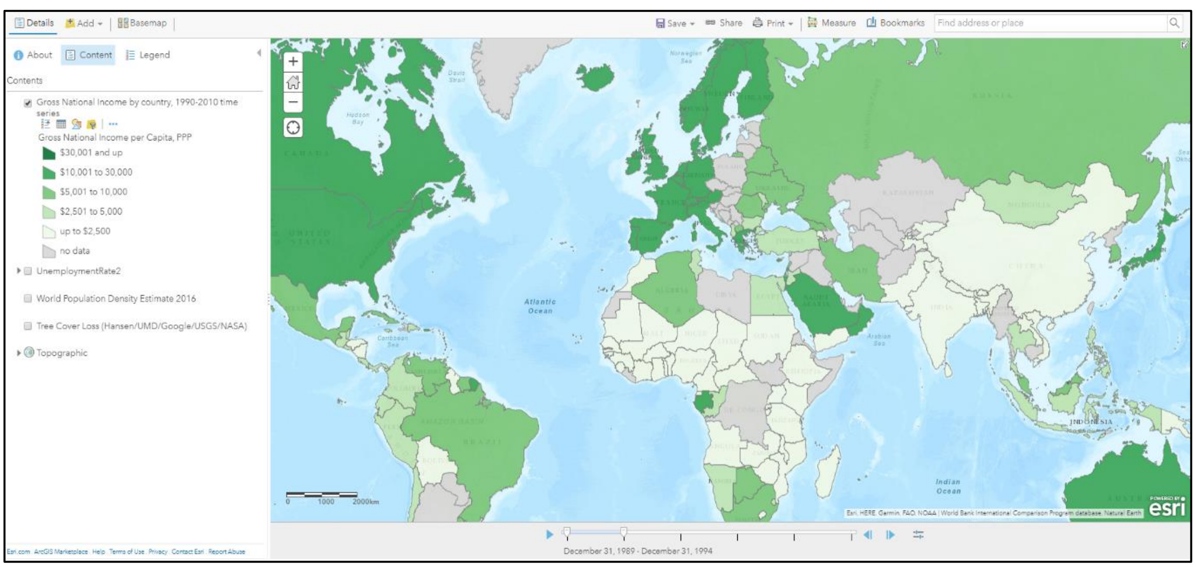


Figure G12. Gross national income ArcGIS Online map hosted by ESRI

3. Sumative Performance Task

After students completing the three supporting questions, they will have knowledge about the population growth changes, causes, and consequences. This task ask students to apply their prior knowledge that gained from supporting questions to build their argument. A brief description of summative performance task shown in table G12.

Table G12

Summative performance task description

Summative Performance Task	Argument: Is population growth good or bad for human development? Construct an argument that addresses the compelling question.
Learning Objectives	Students will use the story map app to: Address the good and bad side of population growth on human development.
Materials	Argumentative Essay Instructions & Rubric
Social Studies Practices	Comparison and contextualization, critical thinking skills, geographical reasoning, using and interpreting evidence
GIS Skills	Story map

In this task, the teacher will ask students to construct an argument by using the story map app. Students are free to choose the format for their story (e.g., journal, tour, series, etc.). In their argument, each group will discuss both sides of an argument using specific claims and relevant evidence from their previously created multi-layer GIS maps. This inquiry requires students to demonstrate their understanding and ability to use and interpret evidence to support their claims. As students work in the summative performance task, they will demonstrate their social studies skills such as gathering, organizing, using and interpreting evidence.

In the summative performance task, students should review their work from previous formative performance tasks. This will help them gather information and appropriate evidence to support their claims. Students should work collaboratively to develop their arguments and create their map story. Each group should present their argument in story map format, and share their views with others. It may be helpful for students to review directions and rubric for this activity. The teacher will therefore use an instruction sheet delineating rubric to clearly explain how students can work successfully in this activity. The instruction sheet and rubric you can find them in Materials part after this activity.

In the Summative Performance Task, your students should endeavor to understand multiple perspectives to an argument. They should also review their work from previous Formative Performance Tasks. This will help them gather information and appropriate evidence to support their claims. In this activity, you should engage students to work collaboratively, and remind them to consider all points of view to develop their positions and story map.

To begin this activity, first distribute instructions for creating an argumentative essay to your class (see Material). The argumentative essay instruction sheet explains the purpose and process for creating the argumentative essay. It also clarifies the evaluation process, providing the rubric which you will use to assess their essay. Students must read these directions carefully before beginning work to create their group's story map journal.

To form their argumentative essay, students should follow four main steps. They must begin by first choosing the type of story map they want to use. Then, as a group, they should brainstorm their ideas concerning the benefits and/or drawbacks of world population growth (using notes from previous lessons). Third, they should collect and collate the evidence to support their viewpoints (GIS maps, graphs, and images). And finally, they will write down their argument. To ensure the quality of their essay, they should follow the rubric and instructions in the sheet.

The argumentative essay should contain six main parts: (1) introduction, (2) claim, (3) evidence, (4) counterclaim, (5) rebuttal, and (6) conclusion. Students should write a brief description of their essay with the introduction. For the claim, students should write their answer to the question:" Is population growth good or bad for human development?" They should also provide a brief reason for their answer in this statement. They should then back up their answer with at least three pieces of evidence from their previous activities. They may use maps, images, chart, and examples to support their opinion. For the counterclaim, students should consider the likely opposing points of view to their own, and clarify the other side's positions. With their rebuttal, students will provide evidence that weakens their opponent's perspective. Students will conclude their essay with a brief summary of their argument. Once each group has completed their work, they must submit it to you for formal review. You will use the argumentative essay evaluation form (see Material) to appraise each group's efforts.

Facilitating AIW through the Summative Performance Task. The summative performance task was also designed to facilitate AIW criteria. After completing the three questions, students will write an argumentative essay to answer the compelling question. Students employ GIS maps, graphics, and worksheets to form their judgment. They also use prior knowledge, and its thoughtful application, to answer the compelling question. Students will engage in a debate about how population growth has changed over time. They must also employ their critical thinking skills to examine both perspectives to the argument by analyzing population growth around the world, and interpreting its causes/effects to answer the compelling question. Moreover, in this task, students will work in groups to discuss their opinions, experiences and GIS efforts to build their argument. Sharing opinions and ideas will help students to improve their understanding; self-correction or peer-correction may occur. At the end of this task, each group makes a presentation to deliver their argument and receive feedback. This will lead to increased communication (e.g. written, visual, verbal, and audio) between students. Finally, the argument opens the window for the exploration of different opinions and perspectives. Students will share their own experiences and make connections with real-world situations to develop their argument.

Material

Argumentative Essay Instruction & Rubric Sheet

Purpose

For this activity, you will work in groups to construct an argumentative essay in which you answer the following question “Is population growth good or bad for human development?” You should think specifically about the effects of human population growth on our planet.

Process

Your argument must be written in a story map format. First, you must choose the type of story map you want before writing it. Second, you should brainstorm your ideas about the benefits and/or drawbacks of world population growth (use your notes from previous lessons). Third, collect evidence to support your viewpoints (GIS maps, graphs, and images). Finally, write your argument. Your argumentative essay must include the following parts:

1. Introduction (2 to 3 sentences)
2. Claim (Point of view)
3. Evidence (supporting information - at least 3 to 4 facts)
4. Counterclaim (the opponent’s best argument)
5. Rebuttal (the weakness in the opponent’s argument)
6. Conclusion (a concise review)

Evaluation

Remember that your essay will be graded using the “World Population Essay Rubric”. You should review this rubric carefully before writing your essay. After you finish your map story, make sure that you have included all of the required criteria.

World Population Essay Rubric

	Inadequate 0	Developing 1	Proficient 2	Exceptional 3
Structure	Very poorly organized. Sections not connected, and do not fully address the question	Weak organization. Essay sections weakly connected, and inadequately address question	Well organized. Essay sections clearly connected, and mostly address the question.	Very well organized. Essay sections strongly connected, and fully address the question.
Claim	Off topic	Makes no clear claim	Makes clear claim	Makes clear, well-articulated claim
Evidence	No mention of GIS maps or 3D scene to support claim	Mentions one GIS map or 3D scene to support claim	Mentions two GIS maps or 3D scenes to support claim	Mentions three or more GIS maps or 3D scenes to support claim
Analysis	No illustration, text, facts, or numbers to demonstrate understanding.	Minimal use of examples (not text) to explain the evidence to support claim.	Uses text to explain evidence and demonstrate understanding.	Uses analytical text to explain evidence. Clear demonstration of understanding.
Counterclaim	No mention of counterclaim.	Mentions counterclaim, but no explanation.	Mentions counterclaim with brief explanation.	Mentions counterclaim with clear explanation.
Accuracy	Major factual errors.	Makes more than three minor factual errors.	Makes two or fewer minor factual errors.	Makes no factual errors.
Use of color/ images/ graphs	Little use of color. No images/graphs illustrate connection to ideas.	Students use obvious colors with images to illustrate some ideas.	Students use effective color using GIS maps and images to illustrate most of their ideas.	Students use multiple colors, with images, GIS maps, and graphs to illustrate all of their ideas.

4. Take Informed Action

After students completing their supporting questions and building their argument, they will work on GIS-based project about population growth in Kuwait. This project asks students to work with ArcMap to analyze the population growth in their country to make decision for future growth. Description of take informed action task shown in table G13.

Table G13

Taking Informed Action Task Description

Taking informed action will involve a Project-based GIS	
Taking Informed Action Steps:	**Understand:** Create a GIS map that shows how population has changed in Kuwait, and the effects, and causes of population growth. **Assess**: Create an action plan to address the consequences of population growth in Kuwait. **Action:** Write an e-mail to a policymaker proposing changes to the highly populated governorates to accommodate future growth.
Materials	(A) Overview of GIS Project (B) Project based GIS: Step by Step Instructions

In this inquiry, students will engage in three activities which require them to (1) understand the population growth topic in local context (Kuwait), (2) assess the impact of population growth in Kuwait, and (3) act in ways that allow students to suggest and determine the best solutions for managing population growth in Kuwait. Students should draw their conceptual understanding for “population growth” by considering how it has changed in their country (Kuwait). In this way, students will transfer their knowledge about world population growth to another context. They will be able to evaluate how population growth affects people’s lives in Kuwait. They could also evaluate how the effects of population growth in Kuwait can be similar and/or different from other countries.

For this inquiry, students will engage in project-based GIS to understand both how population growth has changed in Kuwait, and the effects of this change. Students will work with GIS to create their own maps that show the temporal and spatial analysis of population growth in Kuwait. The teacher could develop the project-based GIS worksheet, guidelines and rubric to clarify how students might complete this task in an effective way (See Materials). This task asks students to complete three main assignments to create their own project: (1) Understand, (2) Assess, and (3) Act. Table G14 explains the activities within a GIS-based project.

Table G14

GIS-Based Project Activities

GIS-based Project Phases	Activity	GIS skills
Understand	In this phase students will complete the following five activities: **1. Create their own map:** Students will draw a GIS map of Kuwait's provinces by using the polygon feature. They will then create an attribute table to write down the names of each province, and will use the label feature to display these names on the map. **2. Demographics:** Students will add five fields on the attribute tables for population (1975, 1985, 1995, 2005, and 2015). They will then access Public Authority for Civil Information Data online to gather the what they need to fill out the table. **3. Spatial Representation:** Students will use Symbology features to visually show the population for each of Kuwait's provinces on the map. **4. Population Growth:** Students will show the attribute table for population growth and discuss their findings with their peers. **5. Fieldwork:** Students will interview a grandparent to ask them about how the population of Kuwait has changed. They will ask them for their views about the underlying reasons for this change, and its consequences. Students will then insert their findings on their map by adding Map Notes.	* Draw polygon * Create attribute table * Show labels *Add fields *Symbology *Show map layers *Add map notes *Geo-Form app
Assess	As a demographer: Is population growth in Kuwait good or bad? Why? Provide some suggestions for controlling Kuwaiti population growth.	*Find and add data *Use configure pop-up tool to create bar chart * Use analysis tool
Act	**Action Phase:** Writing Email Write an e-mail to a city policymaker citing your ideas to control Kuwait population growth.	*Create story map journal

As described in Table G14, the project-based GIS activities engage students in three main phases; (1) Understand; (2) Assess; and (3) Act. The following section explains activities for each phase:

Understand Phase. Students will work collaboratively to create a multi-layer map to understand how population has changed in Kuwait. Teachers will give students the project instructions sheet, rubric, and step-by-step instructions to help students to complete this task. The materials for this task attached after this activity.To accomplish this, students will engage with the following four activities:

- In the first activity, students will insert population data for five Kuwaiti governorates for five different years into their map. Students will use the symbology property to create bar charts that show population figures for each year in each governorate. This will allow students to visually track how population has increased in Kuwait over these five years.
- In the second activity, students will focus on the final year and quantify representing data to spatially explore the highest and lowest populated governorates in Kuwait.
- In the third activity, students will insert the birth rate for both Kuwaitis and non-Kuwaitis in each governorate during the previous five years. Students can take advantage of the symbology property to visually show these data. In this task, students compare Kuwaiti and non-Kuwaiti numbers to learn how migration can lead to dramatic population increases in Kuwait. They can also investigate how birth rate affects population numbers.
- In the fourth activity, each student will interview someone born before 1965, and ask them about the effects of population growth in Kuwait. Students will then meet and summarize their interview results, then enter their data into the GIS map. They can also insert images that add further detail to their results about the effects of population growth. After completing GIS map data entry, students will add a northwards compass arrow, a bar scale, legend, and title to their map. This step will inform students about some of the key elements required for making a map accessible to others.

Assess Phase. Teachers will ask students to create a plan of action to address the problems that they discovered regarding population growth. As a group, students will discuss how they can solve these problems and suggest some solutions.

Act Phase. As demographers, each group will suggest solutions to control population growth in Kuwait based upon data in their GIS map. They will also propose changes to population distribution that would accommodate future population growth, then write an email to a city policymaker citing these ideas. After finishing this task, each group will present their project to the class and take suggestions, comments and feedback from their teacher and peers.

Facilitating AIW through the Taking Informed Action task. The taking informed action task should facilitate AIW criteria. This task engages students to work with GIS to explore the population growth topic in Kuwait by applying knowledge and skills rather than just using facts. They use analysis tools to visually present their data. Students will employ higher order thinking to construct their knowledge about population growth in Kuwait. For example, students will work in groups to find data, add data, and create their own GIS maps. Students work as demographers to analyze the population growth in their country, and make informed decisions to control this growth.

Moreover, this task is designed as a GIS-based project in which students work in groups to create their own research. Discussions with fellow group members should be facilitated to improve their project. Students must make a final presentation to show their work and receive feedback from others. These opportunities support communication, collaboration, conversation, and discussion between students.

And finally, the task offers students the opportunity to connect the topic with their personal experiences. For example, students will interview someone who was born before 1965 to explore how population growth has changed in Kuwait, and how this change has affected their lives. Students will also communicate their ideas regarding population control in Kuwait, and send appropriate mitigation techniques to policymakers. These activities will lead to increased student AIW and create a social interaction environment that will improve student learning.

Materials of Take Informed Action Task

Materia A: Overview of Project Sheet

Life by the Numbers: A Kuwait Case Study Project

Purpose

The aim of this project is to explore how population has changed in Kuwait. Through working with ArcMap, each group must answer the guiding questions below. You can follow the GIS Project guidelines to learn how you can use the ArcMap. After finishing your map and completing all activities, make your presentation. The presentation should answer the guiding question and be supported with the GIS maps you created.

Your presentation can be made in whatever format you want. Remember that your project will be graded using the "Project-based GIS Rubric". You should review the rubric carefully before working on your project. After finishing your project, make sure you that you have met all of the required criteria.

Happy projecting!

Project Resources

Kuwait Provinces Map

The Public Authority for Civil Information Data (http://stat.paci.gov.kw/)

Fieldwork

Guiding Questions

How has the population changed in Kuwait?

What are the effects of population growth in Kuwait?

What are the reasons behind population growth in Kuwait?

How could we control rapid population growth in Kuwait?

Activity 1: Demographics

ArcMap: insert the population number for each governorate in at least five different years. Convert the data to a bar chart.

Consider: Does each year have the same population? Explain

Activity 2: Spatial Representation

ArcMap: Covert data from the last year into spatial quantities.

Consider: Do all governorates in your country have the same population? What is the connection between these numbers? Explain.

Activity 3: Population Increase Rate

ArcMap: Insert the birth, rate for Kuwaiti and non-Kuwaiti citizens for each governorate in the five previous years, then covert the data into charts and colors.

Consider: Have birth rates and non-Kuwaiti citizen numbers increased over these five years? Why? Explain.

Activity 4: Fieldwork

Interview your grandparents or someone born before 1965, and ask them about how the population has changed in Kuwait? What are the results of these changes? What problems are related to these changes?

ArcMap: Open your map and insert the results of population increases and add an image.

Consider: Are the consequences of population growth in Kuwait good and/or bad? Why? Explain.

Demographer Role

As a demographer:

- How can population growth be controlled? Suggest some solutions for controlling Kuwaiti population growth.

- Write an email to a city policymaker citing your ideas to control Kuwaiti population growth.

Project-based GIS Rubric

		Needs Work (1)	Competent (2)	Excellent (3)
GIS Map	GIS Map Activities	Complete minimal GIS map activities	Completed most GIS map activities	Completed all GIS map activities
	GIS Map Quality	Low quality: - No cartographic elements on map - Text and image size too small. - Use of unclear color	Medium quality: - Some cartographic elements appear on map. - Text size good - used clear color and images	High quality - Essential cartographic elements all on map - Text size good - used clear color and images
Interview		Interview results do not answer guiding questions.	Interview results answer one or two guiding questions.	Interview results answer all guiding questions
Demographer Role (e-mail)		Weak suggestions or ideas which do not solve problems related to population growth.	Good suggestions or ideas which temporarily solve problems related to population growth.	Excellent suggestions or creative ideas which solve problems related to population growth.
Presentation	organization	Presentation poorly organized	Presentation loosely organized	Presentation is organized and well laid out
	Content	Presentation does not answer all guiding questions, and no use of relevant evidence to support thesis.	Presentation answers all guiding questions, but without using relevant evidence to support thesis.	Presentation answers all guiding questions while using relevant evidence to support their thesis.
	Use of visual aids	No visual aids, or visual aids that are inappropriate. No mention of visuals in the presentation.	Use visual aids, but hard to use/understand, No mention of visuals in the presentation.	Uses appropriate and easily understood visual aids Explains the visuals in the presentation.
	Communication	Presentation is boring. Audience is confused and uncommunicative with presenter	Presentation is mildly interesting. Audience asks questions but some remain unanswered.	Presentation highly interesting. Audience asks questions, which are answered effectively.
	Presentation Skills	Voice too quiet. No gestures, eye contact or body	Voice is clear. No gestures, eye contact or body language to engage students.	Voice is clear and strong. Gestures, eye contact and body language engage students.

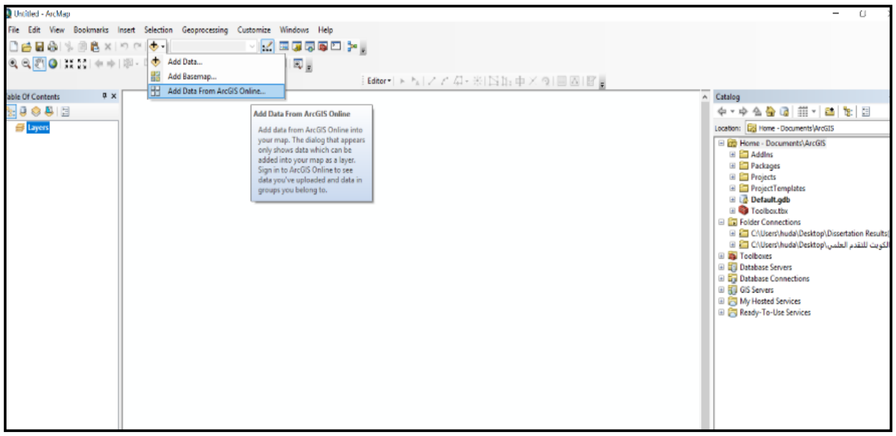
		language to engage students.		
Cooperation		Little or no teamwork is noted.	Attempts to work collaboratively but some students "off task" at times. Not everyone is actively involved.	Collaborative well and all students actively involved.

Material B: Project Step-by-Step Instructions

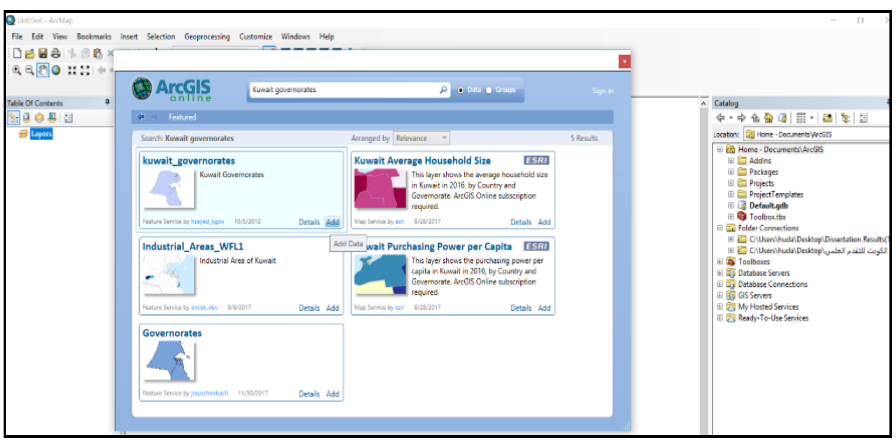
Life by Numbers Project a GIS Steps Guidance

Activity 1. Create your own map

1. Open ArcMap→ Click on Add Data→ Add Data from ArcGIS Online.

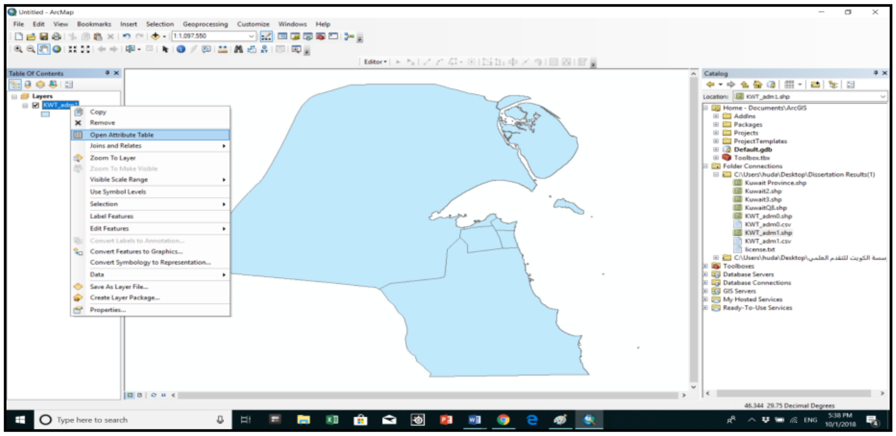


2. In the search box, type "Kuwait Governorates"→ choose Kuwait - governorates map→ click Add.

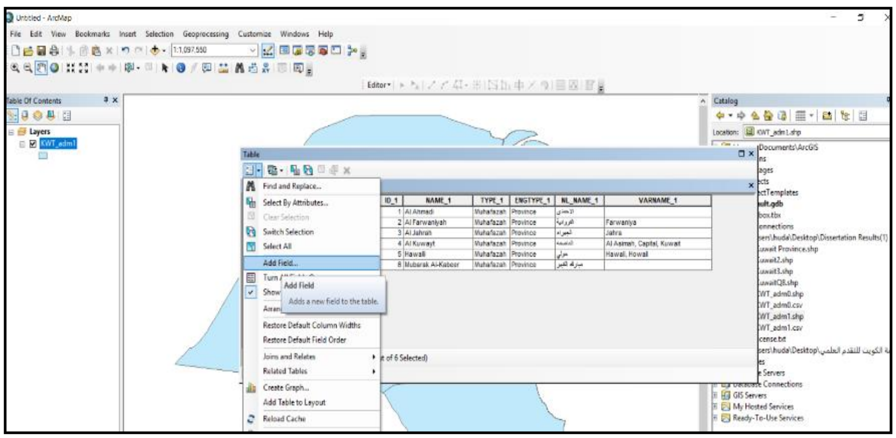


Activity 2. Demographics

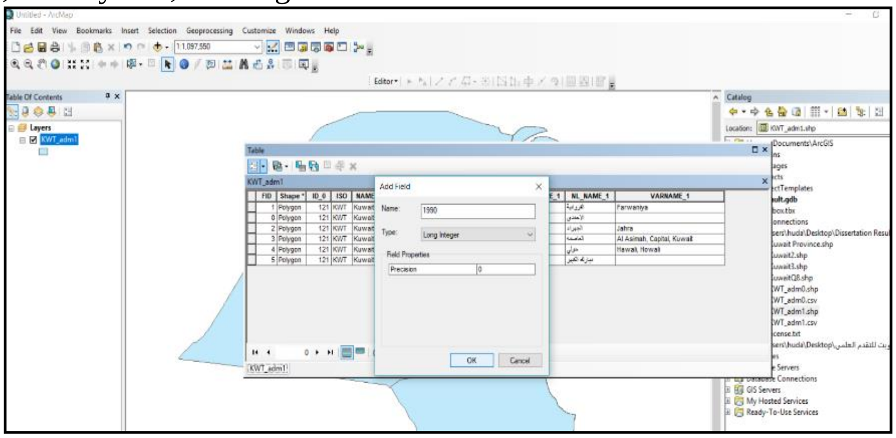
1. In the table of contents→ right click on layer→ choose open attribute table.



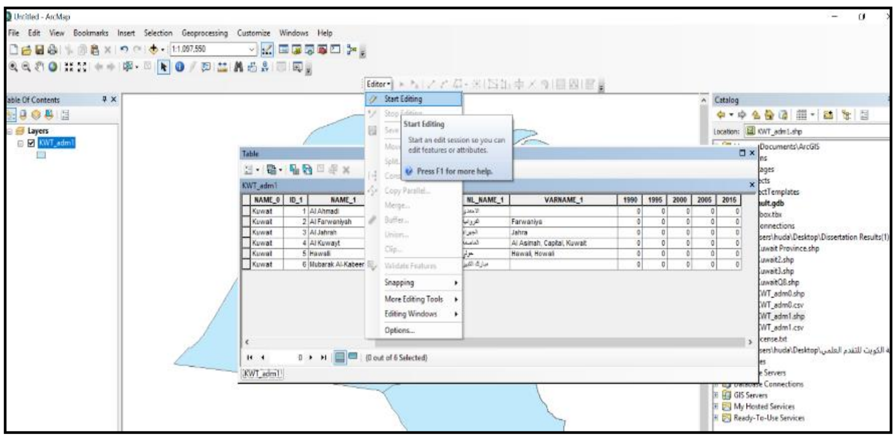
2. In the attribute table box→ Click in table options→ click in Add field



3. Enter the name of the field (the year of population data) for example (1990) → choose the type is long integer→ then click OK. Add five fields (Population data for 1975, 1985, 1995, 2005, and 2015). In each year, you will add population number, births, deaths, fertility rate, and migration rate.

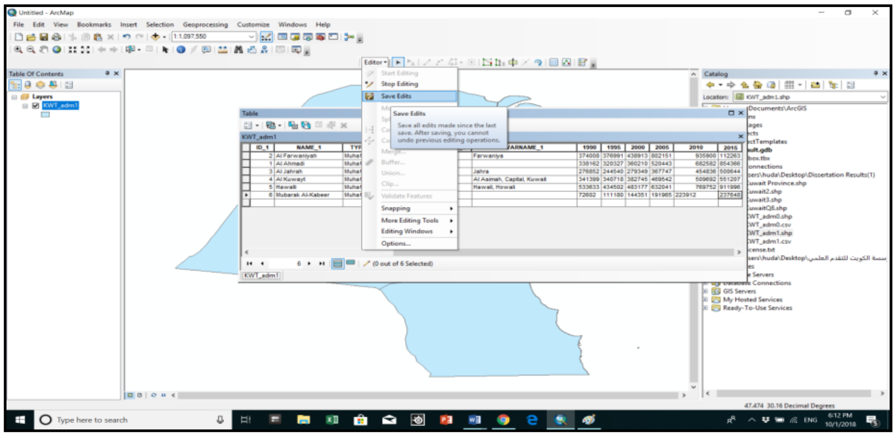


4. Click on Editor→ Start Editing



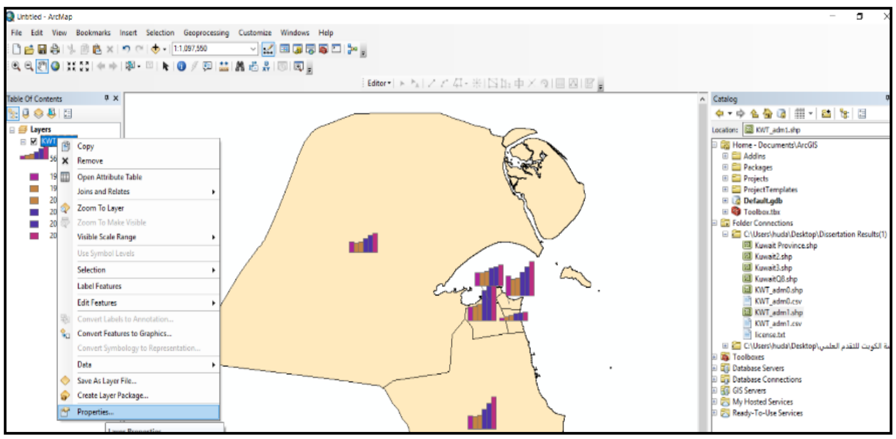
5. Go to http://stat.paci.gov.kw/ to add the population data for each year in each province.

6. Enter the population number for each year in each governorate→ click save edits

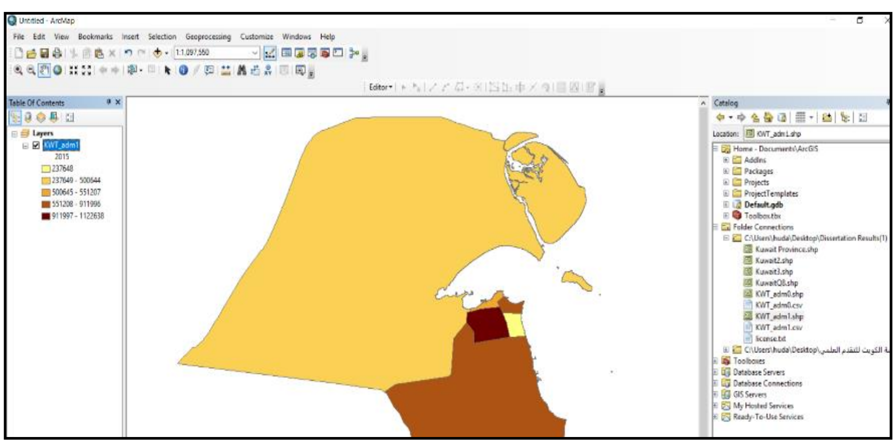


Activity 3. Spatial Representation

1. In the table of contents→ right click on Kuwait layer→ choose properties



2. Click on symbology→ choose Quantities→ in the value choose the last year you typed → click apply



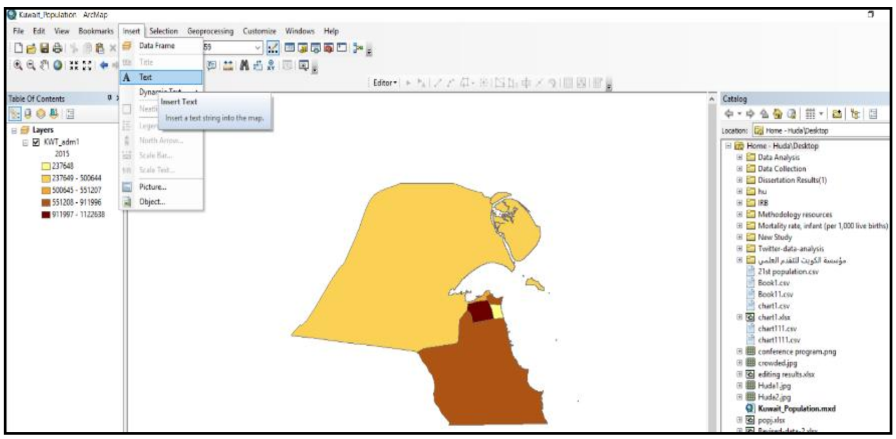
- See the map and discuss the following question with your group: Do all governorates in your country have the same population? Explain.

Activity 4. Population Growth

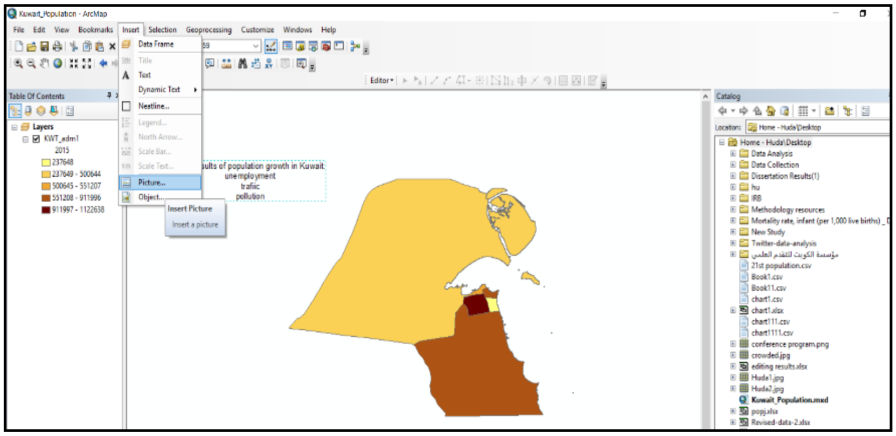
- On the polygon layer, click on each province to show details about population data from 1975 to 2015
- Discuss the following question with your group: Have population numbers increased over 35 years? Why? Explain. You can do a Google-search to identify the reasons behind population growth in Kuwait.

Activity 5. Fieldwork

1. Go to toolbar→ click on insert→ Text→ write your brief interview results

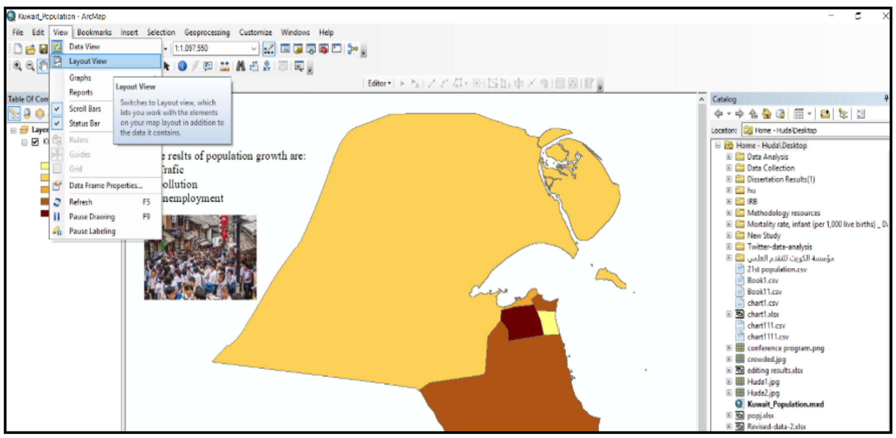


2. Go to toolbar→ click insert→ Picture→ choose your saved picture

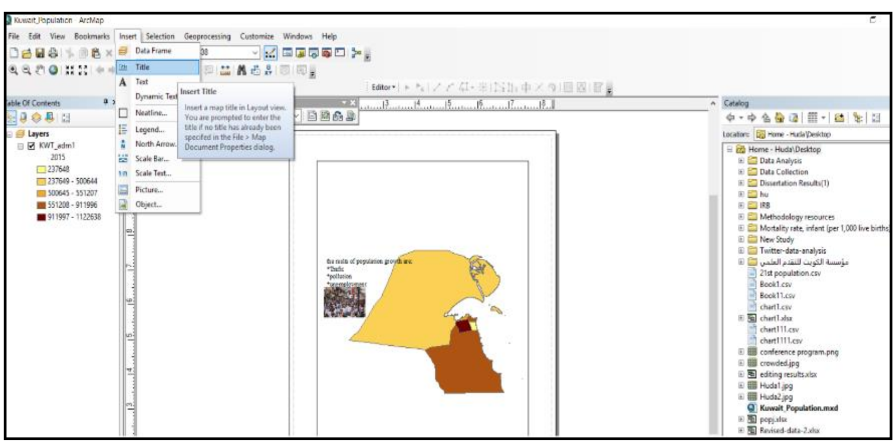


Finish your Map: Cartographic Elements

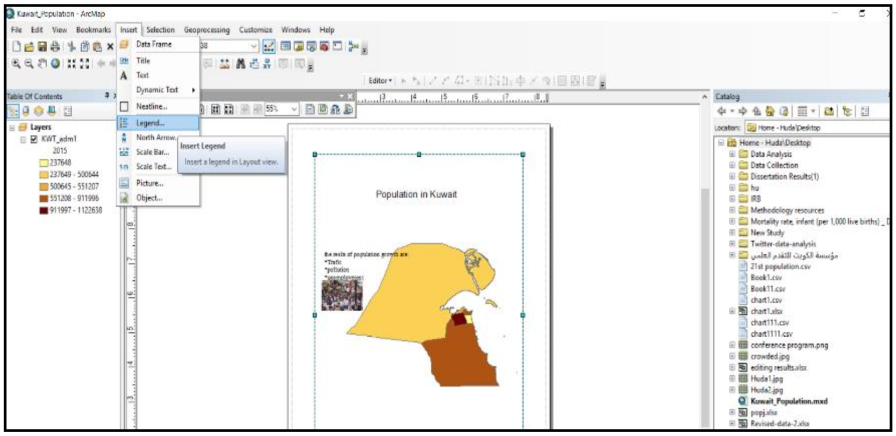
- Go to toolbar→ click view→ layout view



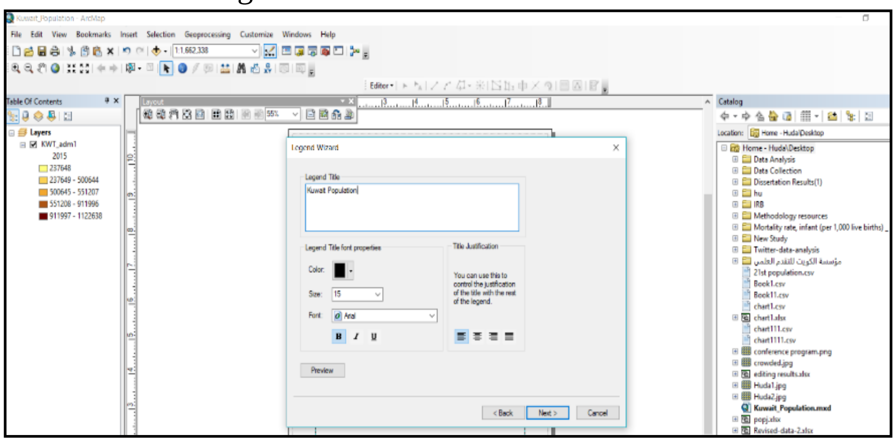
- Go to toolbar→ insert→ Title→ write the title of your map.



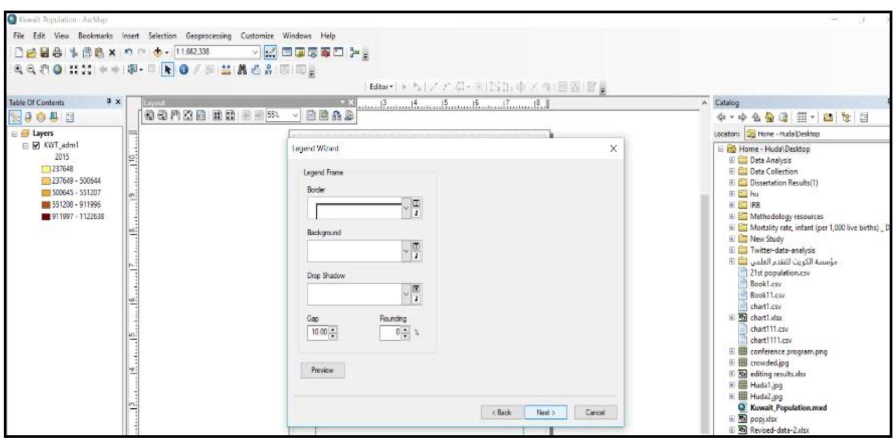
- Go to toolbar→ insert→ Legend



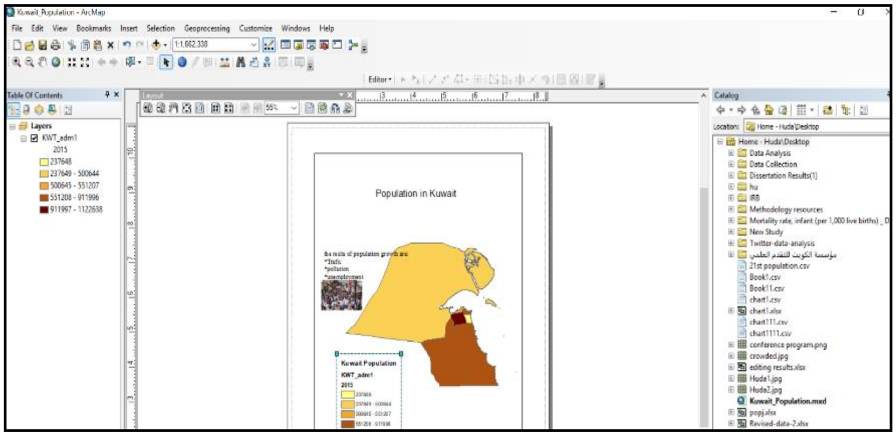
- Click next→ write the legend title→ click next



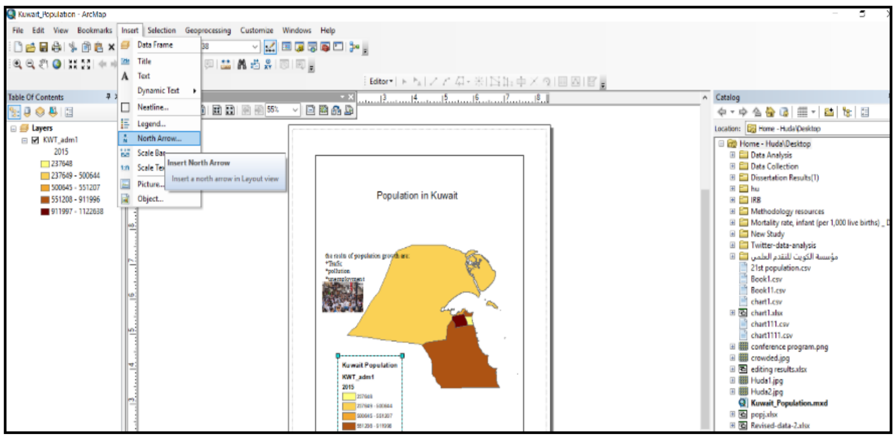
- Choose the border, background, and drop shadow→ then click next



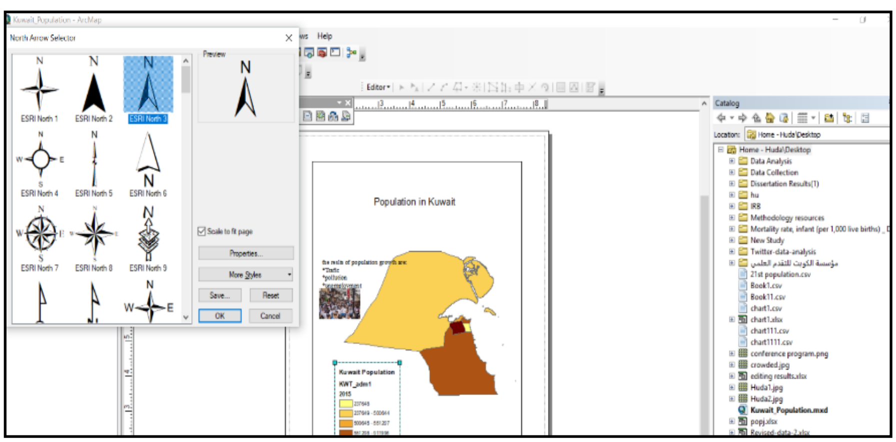
- Click next→ then finish



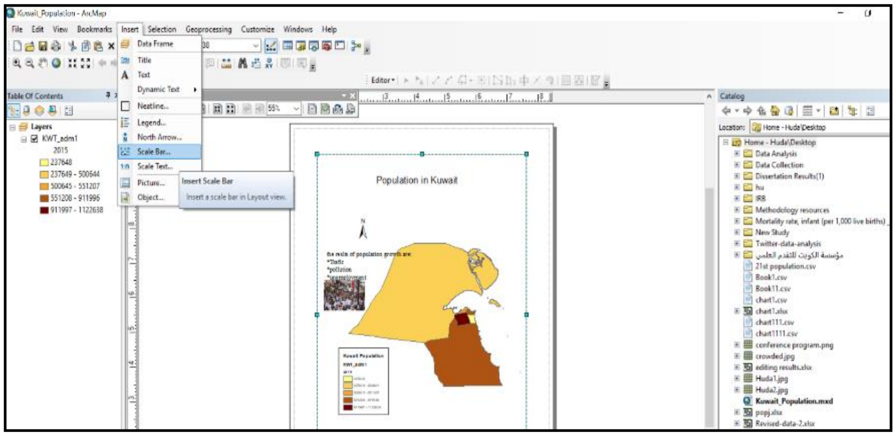
- Go to toolbar→ click insert→ North arrow



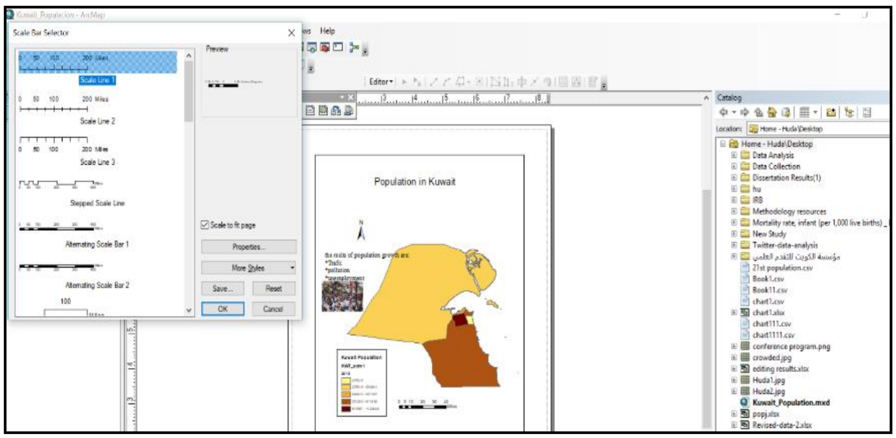
- Choose North arrow→ click OK



- Go to toolbar→ click insert→ choose scale bar



- Choose the scale bar→ click OK



- You can repeat the previous step with each layer you want to layout. Now you can print it or save it.