The Construction of an Instructional Design Framework that Incorporates the Repurposing of Popular Media to Enhance Mathematics and Science Instruction

By

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ABSTRACT

This study was an effort to construct and validate an instructional design framework for media content selection that incorporates repurposing popular media to enhance mathematics and science instruction. The study resulted in the development and validation of a framework that was applicable with novice and expert instructional designers to be used as a stand – alone model or as a supplement to widely-used instructional design models. The framework was developed based on the literature review of four constructs: instructional design models, repurposing popular media, learning theories and the new generation learners' characteristics, and multidisciplinary or integrated approaches to instruction. The findings of the literature review were used as the theoretical foundation for the construction of the framework for media content selection. During the final step of the study's Phase One, the researcher used the first iteration of the framework to develop a short instructional module that incorporated the repurposing of popular media. This instruction focused on early mathematics (K-2) and the repurposing of full-feature children animated films. The goal of this step was the development of documentation to record the process for media content selection that was later used to modify and revise the framework.

As the next step, the framework was validated by subject matter experts in the field of instructional design. The framework was then further revised and modified. The findings of this study have implications on the areas that pertain to (a) instructional design models, (b) media selection, (c) media content selection, and (d) curriculum integration. Based on the findings of this study, recommendations to practitioners choosing to use the framework for media content selection were suggested and suggestions for future research were provided.

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Chapter 1: Introduction and Need for the Study

Numerous models exist in the field of instructional design and technology (IDT) that assist designers working in a variety of settings and environments (Gustafson & Branch, 2002a). Many existing models are refined and enhanced to take into account the new understandings of learning and instruction (Dick, Carey, & Carey, 2005; Morrison, Ross, & Kemp, 2004).

Instructional development is a complex process and practitioners rely on instructional models to guide them through this process. Models, in general, help us conceptualize representations of reality; therefore, they are used as simple representations of more complex processes and functions of ideas or physical phenomena. Instructional models serve as conceptual and communication tools for analyzing, designing, creating, and evaluating new learning experiences.

With the invention of the Internet, a new generation of instructional models emerged. The expansion of E-learning, the World Wide Web, and, in recent years, the emergence of mobile learning has stressed the need for the creation of innovative design models to support new learning environments and paradigms. For example, to accommodate a new generation of distance learning, novel models that integrate both constructivist and objectivist approaches were developed (Passerini & Granger, 2000).

Another challenge for instructional designers is the selection of media. For almost a century, educators have been concerned about choosing the appropriate media to deliver an instructional message in particular instructional situations. How should educators go about selecting media? A number of media selection models have been developed in an attempt to answer this question (Reiser & Gagne, 1982). Media are resources that can be considered to be learning-enabling tools, which if selected properly, can enhance cognitive processing and affect learning efficiencies (Jonassen, Campbell, & Davidson, 1994).

The growth in use of multimedia within the education field has accelerated in recent years, and this trend is set for further expansion. One of the questions that is of a great interest to the author of this study is the ways that multimedia can help in the learning of mathematics and science. One way of using multimedia is to provide a historical background for a mathematics or science concept. For example, *The Mechanical Universe*, a videodisc series produced by the Annenberg Foundation, includes many historical vignettes, such as Sir Isaac Newton's explanation of circular motion (Blinn, 1991).

One more possibility in which multimedia can be used to provide a context for mathematics is problem solving. Multimedia material provides a rich visual and audio context for a problem as in the Jasper videodisc series developed by cognition and technology group at Vanderbilt University's Learning Technology Center. The adventure of Jasper Woodbury series is an example of an approach to teaching known as "anchored instruction", where a narrative connects or anchors mathematical concepts to realistic complex situations. In this way, the concepts are tied to meaningful problems and outcomes (Barron & Kantor, 1993).

Although researchers have pointed out that multimedia (TV shows, Movies, and video games) have a great potential of enhancing learning experiences for students, the development of the process of selecting and utilizing multimedia for specific learning objectives, especially in

STEM disciplines, have been left mostly untouched. Looking into these questions can help instructional designers and practitioners to diagnose problems while developing instruction, bypass application pitfalls, and increase effectiveness of new learning experiences in the field of mathematics and science.

Statement of the Problem

Instructional designers and researchers whose first concern is to develop, investigate and evaluate instructional models choose their topics and domains in such a way that the effectiveness of these models can be best examined. For example, Discovery Learning is primarily investigated using the domain and topics of science. The situation is different for instructional designers, teachers, and educators who need to develop instructions in specific domains, such as mathematics or physics. For these practitioners, the specific domain comes first and their primary commitment is to solve specific teaching and learning problems within this domain. In the process of addressing these problems, they may use or adapt generic models (Boshuizen et al., 2007). For example, problem-based learning (PBL) was first developed in medical education (Barrows, 1984) but later was used in engineering and economics fields.

Models do not automatically or perfectly fit specific domains, topics, skills, or competencies; therefore, instructional models must be invented, reinvented or significantly modified for a particular domain. For example, highly successful 5E (Engagement, Exploration, Explanation, Elaboration, and Evaluation) instructional model (Bybee, 1997) was originally developed for teaching biological sciences. It has gained in popularity across other sciences education community and was later expanded to 7 phases (Engagement, Elicitation, Exploration, Explanation, Elaboration, Evaluation, and Extension) and became known as 7E learning Cycle (Eisenkraft, 2003).

Multimedia repurposing has been an area which received considerable attention by researchers. Educational content repurposing is a widely-used activity among educators. Although, not formally acknowledged as such, educational content repurposing is what any educator is routinely engaged in when preparing a new learning experience for her students, including preparing the educational content itself. Usually, when educators set objectives, goals, and a context of a new learning experience, they overview existing content materials, search for new related content, and then repurpose and reorganize content to fit the purpose of the new learning experience. Therefore, they do not merely "reuse" the content since this refers to the reuse of an educational resource "as is" (Meyer, Hildebrandt, Rensing, & Steinmetz, 2006).

The results of several studies (Alvarado & Maskiewicz, 2011; Harwood & McMahon, 1997) revealed that integrated media is "an instructional tool that can be used effectively to bring the often abstract, distant worlds of science into close focus and within the personal meaningful realm of each individual student"(Harwood & McMahon, 1997, p. 617).

However, a review of literature, to date, shows no research concerned with the investigation involving the incorporation of repurposed popular media into instructional models to enhance science and mathematics instruction.

Purpose Statement of the Study

The purpose of this two-phase, design and development study was to develop and internally validate a Framework for incorporating the repurposing of popular media into existing instructional design models, and, thereby, engage students in STEM disciplines and promote learner knowledge.

Research Questions

There were two phases in the study which were guided by the following research questions:

Phase One

1. What are the theoretical foundations from Instructional Systems Design theories that provide for the development of the Framework that incorporates the repurposing of popular media to enhance mathematics and science instruction?

2. What are the theoretical foundations from the learning theories that provide for the development of the Framework that incorporates the repurposing of popular media to enhance mathematics and science instruction?

3. What are the findings from the practice of repurposing of popular media that provide for the development of the Framework that incorporates the repurposing of popular media to enhance mathematics and science instruction?

4. What are the findings from the practice of integration/multidisciplinary links that provide for the development of the Framework that incorporates the repurposing of popular media to enhance mathematics and science instruction?

5. What are the components of this Framework that incorporates the repurposing of popular media to enhance mathematics and science instruction?

Phase Two

1. What are the components of the Framework that incorporates the repurposing of popular media to enhance mathematics and science instruction that have been validated by experts?

2. What are the advantages (and disadvantages) of using this Framework? Factors to consider include the following:

a. Ease of use

b. Capability to meet instruction intent

c. The ease of instructional design strategy creation utilizing popular media

d. Ability to incorporate national and local standards

e. Ability to incorporate content matter accuracy

f. Ability to incorporate subject integration

Organization of the Proposed Study

Chapter 1 provides background information to the study, statement of the problem, purpose statement of the study, and research questions.

Chapter 2 includes a review of the literature related to this study. This chapter consists of four sections. The first section is a discussion on instructional models. It includes an overview of the origins of the instructional development models, the role of models in instructional development, the taxonomy of models according to several prominent authors in the field, a selected review of ID models, and the discussion on media selection models. The second section provides an overview of the repurposing of popular media. The third section discusses the evolution of learning theories and their influence on the practice of instructional design as well as the characteristics of the new generation of learners. Finally, the fourth section discusses the research on integration and multidisciplinary links.

Chapter 3 provides information related to the methodological approach that was taken to answer the posited research questions. This chapter contains a discussion of the research design, data collection procedures, research instruments, and procedures for data analysis. Another focus of Chapter 3 is findings from the four sections of the literature review that provide for the construction of the Framework.

Chapter 4 describes the creation of the first iteration of the Framework and its use to develop an instructional module on early mathematics.

Chapter 5 provides information on the Framework validation by a panel of expert reviewers and the Framework revision from experts' feedback.

Finally, Chapter 6 offers discussions, recommendations, and final thoughts on the development process of the Framework for media content selection.

Chapter 2: Review of Literature

This chapter is a review of literature related to the study. The review of literature includes investigation of four constructs (instructional design models, the repurposing of popular media, learning theories and the new generation learners' characteristics, and multidisciplinary or integrated approach to instruction). The findings of the literature review were used as the theoretical foundation for the construction of the new Framework for media content selection.

Review of Literature on Instructional Models

Introduction. Although researchers still debate the exact origins of the instructional development (ID) process, it is suggested by Gustafson and Branch (2002b) that the writings of Silvern (1965) represent an early attempt to apply General Systems Theory (GST) to the design of instruction. Silvern was particularly interested in how GST could be used to create effective and efficient training for aerospace and military instruction and published what might be considered the first ID model, although he used the term *instructional systems.*

By the early 1970's, the use of instructional systems design (ISD) methods became prevalent in many branches of the military and had started to be applied in commercial and industrial settings (Branson, 1978; Branson, Rayner, Cox, Furman, & King, 1975). Soon, ISD became accepted as a major training methodology by many educational organizations and is now widely used throughout the world.

As explained by Gustafson (2002b), Silvem's model and many other early ID models were based in behaviorism, broadly defined as the philosophy and values associated with the measurement and study of human behavior (Burton, Moore, & Magliaro, 1996). Gustafson further notes that,

> although many now associate Behaviorism with Stimulus and Response theory, most of the early writers had far more encompassing theoretical and philosophic perspectives. Essentially, these behaviorists believed, as many ID practitioners believe today, that behavior can be observed, measured, planned for, and evaluated in reasonably valid and reliable ways. (Gustafson, 2002b, p. 17)

Cognitive psychology, particularly from the perspective of information processing, has also made major contributions for the theory of instructional design. Especially valuable in this respect the research by the late Robert Gagne who was one of the founding fathers of IDT field. Gagne and his colleagues (1992) introduced four fundamental principles of human learning that form the basis of instructional design. These principles are: a) Contiguity-learning materials and the expected response must be presented at the same time, b) Repetition - the learning materials and their expected outcomes are required to be repeated many times for improved learning and for knowledge retention, c) Reinforcement – learning a new task is enhanced each time the learner is rewarded for his or her performance. This reward can be internal or external, and d) Social-cultural principles of learning – the need for picture illustrations, frequency of graphical presentations, and the rate of instructions are all used to predict the learning and retention of knowledge.

Gagne also introduced the five general categories of learning outcomes (intellectual skill, cognitive strategies, verbal information, motor skills, and attitudes) that are used throughout the world. One of the most helpful principles for designing instruction has long been, and continues to be, the nine events of instruction that are based on Gagne's learning principles.

Some of the recent studies concern the development of instruction using newer models and procedures of instructional design that reflect the influence of cognitive science and constructivism. For example, Cronje (2006), has constructed and tested a new model that integrates the traditionally conflicting objectivist and constructivist approaches to instructional design. Chapter 7 of the fifth edition of Gagne's book (2005) provides reasons for defining learning objectives with appropriate considerations of constructivist concerns. The authors' position is appropriately explained and they state that "both approaches (constructivist and instructivist) are means to ends, not ends in themselves" (p. 133).

Karagiorgi and Symeou (2005) note that constructivism makes a different set of assumptions about learning and suggests new instructional principles in comparison to traditional instructional systems approaches. However, traditional design practices do not merely accommodate constructivist perspectives; therefore, the application of constructivist principles to design of instructions present certain challenges for practitioners. At the same time, as explained by the authors, the application of constructivism to instructional design has certain advantages such as more meaningful learning outcomes, more independent problem-solving capability and more flexibility in both design and instruction activities. Nevertheless, most designers do not unconditionally embrace this new epistemology as there are many areas of conflict (Karagiorgi & Symeou, 2005).

Rationale for instructional design. Instructional designers believe that the use of systematic design procedures in producing instruction, make instruction itself more effective, useful, and relevant than less rigorous approaches to planning instruction. This systematic approach implies coordination and connections between instruction components and requires analysis of all activities. If the systematic thinking is not used in the process of designing a certain instruction, there is always a danger of major incongruities among goals, strategies and evaluation (Gustafson & Branch, 2002b). For example, as explained by the authors, students may think they know what will be on their next test, only to find out that the test concentrates on some factual materials rather than on concepts.

Reiser and Dick (1996) argued that a systematic approach to instruction has been shown to be an effective model due to its focus on clearly identifying goals and systematically developing instructional activities and assessment that lead to the attainment of the goals.

Based on the analysis of 40 models, Andrews and Goodson (1980) concluded that instructional design models can serve the following purposes:

• Improving learning and instruction by following a systematic approach

• Improving management of instructional design and development procedures by monitoring and controlling the functions of the systematic approach

• Improving evaluation processes (including learner performance)

• Testing or building learning or instructional theory by means of theory-based design within a systematic instructional model.

Brief overview of instructional design models. Gagne and colleagues (2005) defined instructional design as an arrangement of resources and procedures used to promote learning . Instructional design models are visual representations of the ID process and are used to guide design in many settings and for many purposes (Seels & Glasgow, 1998). Instructional models are a result of the combination of abstract principles of General Systems Theory and analyses of practitioner experience (Banathy & Jenlink, 2004). Walter Dick (1981) suggested that these models serve as the theory for instructional designers. There is a difference between learning theories (which will be discussed later) and instructional design theories. Learning theories are the study of how people learn. Instructional Design Theories are the study of how to design the most effective and efficient instruction so that learning will take place. Instructional design theories, hence, are drawn from learning theories.

There is a great amount of instructional models that guide designers and practitioners in the field but the researcher is going to briefly mention just a few of them. They were chosen based on their historical impact on the discipline, their applicability in a variety of settings, learning environments, and audiences, as well as their contribution to the theoretical foundation of the IDT field.

IDI model. A group known as the Special Media Institutes Consortium, which included representatives from four Universities - Michigan State University, Syracuse University, University of Southern California and United States International University - developed an Instructional Design model referred to as the Instructional Development Institute (IDI) model in 1971. The model could be considered as having three phases (analysis, design, and evaluation), each of which was broken into three steps, of which each was further broken into two or three activities. This model has historical significance and is famous for its use in teacher training.

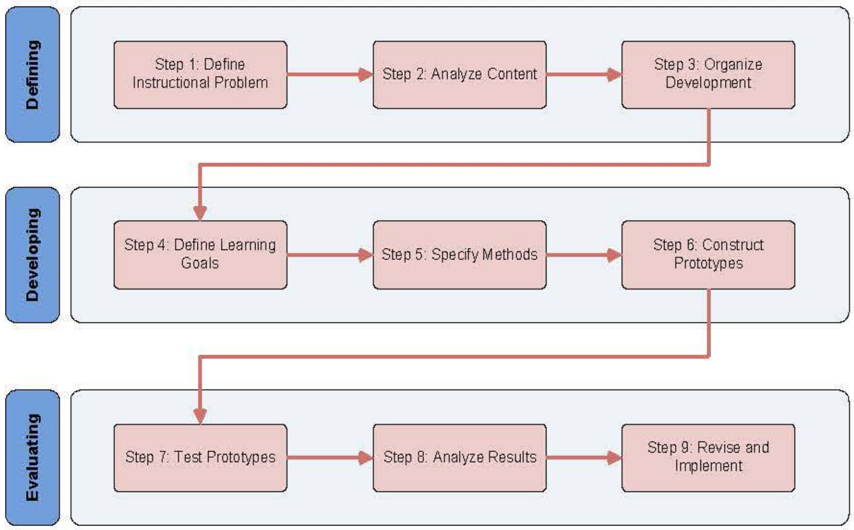

Figure 1. The IDI model (UCIDT, 1973)

Dick and Carey model. Presently, as stated by Gustafson and Branch (1997), the most widely adopted model related to the ID process is Dick and Carey model (1996). The authors further explain that the popularity of the Dick and Carey model can be partially explained by its very readable text and the authors' continually updating the model to reflect emerging ID philosophy. Dick and Carey also accompanied their model with clear and simple examples of each of the steps and excerpts from cases of its use to provide readers with a frame of reference. Dick and Carey have made minor modifications to their ID model to reflect growing interest in performance technology, context analysis, multi-level evaluation models, and total quality management (Dick & Carey, 1996).

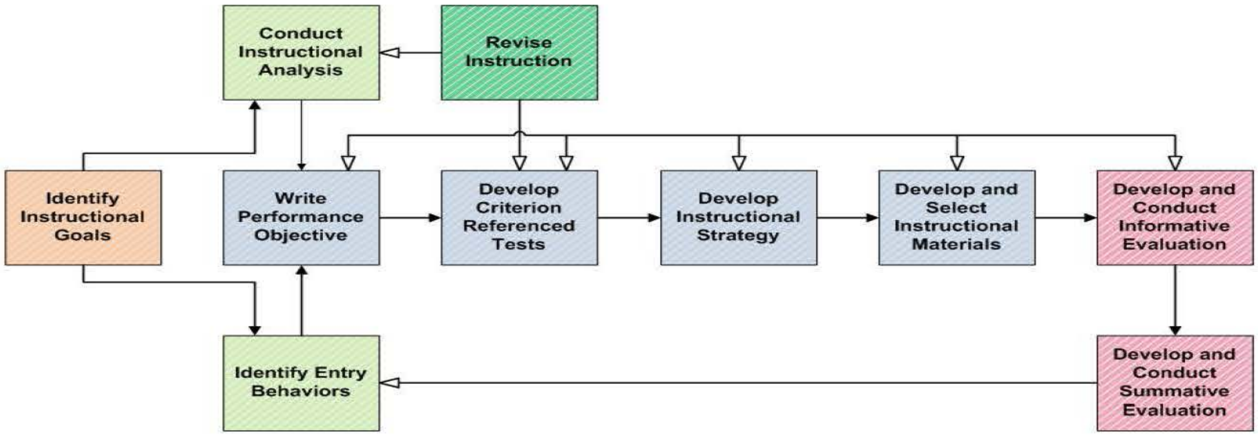

Figure 2. Dick and Carey Instructional Design model

ASSURE model. The ASSURE instructional model, created by Heinich, Molenda, Russell, and Smaldino (1996), has been developed for planning a lesson that incorporates technology to enhance it. The ASSURE model contains six steps and the letters in ASSURE form an acronym. The first letter "A" stands for *Analyze the learner*. The first "S" stands for *State objectives.* The instruction should be based on curriculum to teach in a classroom, with specific objectives that will become the focus of individual lessons. The second "S" stands for *Select media and materials.* First, instructors need to choose a method for delivering their instruction (small groups, whole class, or tutorial), then make media selection to enhance and supplement the method of teaching (software, CD-ROMs, Internet resources, etc.). The "U" stands for *Utilize Media and Materials.* In this step, the instruction is delivered and the media and materials get implemented. This is also the step that should have a backup plan with alternative solutions being available. The "R" stands for *Require Learner Participation.* Students find learning more meaningful when they are actively involved in the learning process and not sitting there passively. Finally, the "E" stands for *Evaluate and Revise.* In this stage teaching and student learning should be evaluated, and the needed revisions should be made.

ARCS model. The ARCS Model of Motivational Design was created by John Keller (1987). The model is based on expectancy-value theory (Fishbein & Ajzen, 1975), which presumes that people are motivated to learn if there is value in the knowledge presented (i.e. it fulfills personal needs) and if there is an optimistic expectation for success. The ARCS model consists of four main categories: Attention, Relevance, Confidence, and Satisfaction. As explained by John Keller, each category has subcategories that are supported by specific psychological constructs that provide theoretical foundation for the components. There is also a list of "job aid" questions that direct the instructor. For example, the question pertaining to "motive matching" under Relevance asks: "how and when can I link my instruction to the learning styles and personal interests of the learners?'

Attention	**Relevance**	**Confidence**	**Satisfaction**
A1 Perceptual arousal	R1 Goal orientation	C1 Learning requirements	S1 Intrinsic reinforcement
A2 Inquiry arousal	R2 Motive matching	C2 Success opportunities	S2 Extrinsic rewards
A3 Variability	R3 Familiarity	C3 Personal control	S3 Equity

Figure 3. ARCS Categories

Morison, Ross, and Kemp model. Morison, Ross, and Kemp model (2004) is known for its non-linier approach and the idea of flexibility. The oval shape of the model manifests the cyclical process of instructional design. The essential concept of this model is that any of the elements can be addressed at any time in the process, giving freedom to the designer to modify their instruction as necessary. Another important attraction of this model is that designers have the choice to decide what elements they need. The lack of lines and arrows make it easier for people to skip around to the components they need to address, and disregard those that they do not.

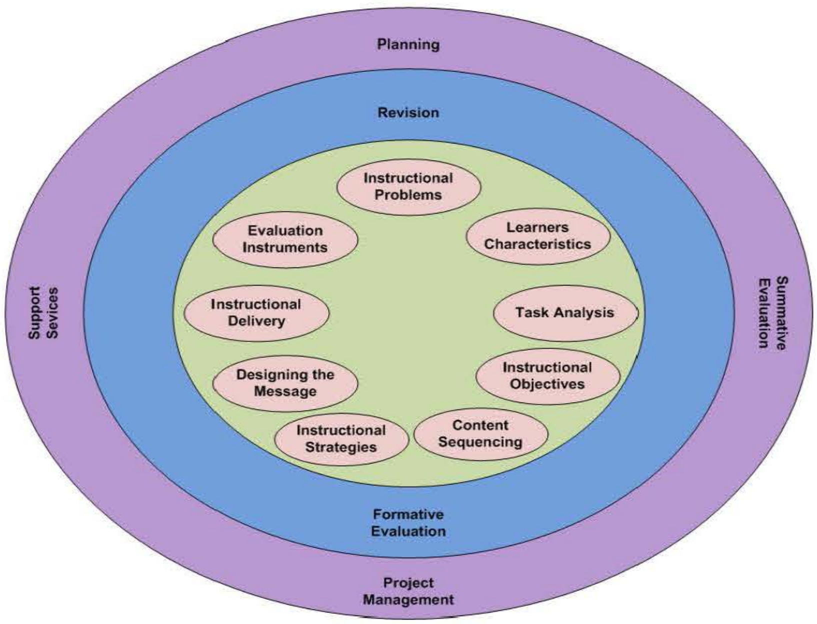

Figure 4. Morrison, Ross, and Kemp model

Reiser and Dick model. The Reiser and Dick model (1996) contains seven steps shown below. There are four important principles that play key role in developing of effective instruction. These principles are:

1. Begin the planning process by clearly identifying the general goals and specific objectives students will be expected to attain; 2. Plan instructional activities that are intended to help students attain those objectives; 3. Develop assessment instruments that measure attainment of those objectives; 4. Revise instruction in light of student performance on each objective and student attitudes towards instructional activities (Reiser & Dick, 1996).

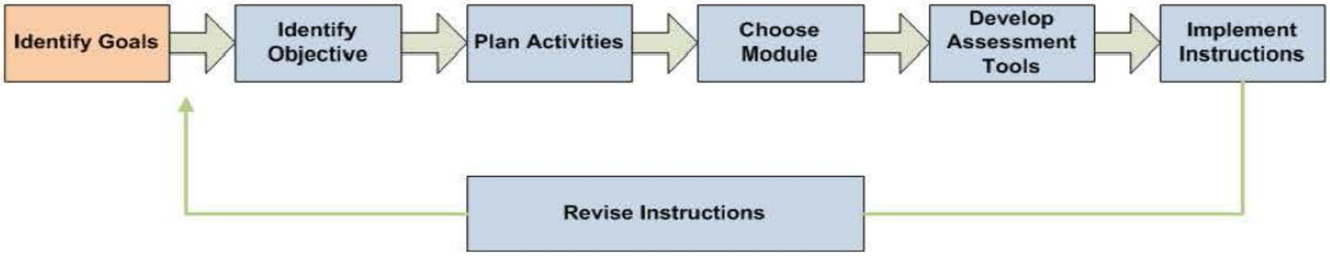

Figure 5. Reiser and Dick model

There are more than 100 instructional design models known today. However, as Gustafson and Branch (2002) note, any one instructional development model may not satisfy all the needs within a defined setting and purpose. Therefore, it is important to identify an ID model through its intended purpose. From there, models can be either fully adopted or adapted to meet the needs defined within the context. Along with a historical survey of research and literature in the field of ID, Gustafson and Branch (2002) also present the taxonomy for classifying existing models of ID. The classifications include *classroom-oriented, product-oriented and system-oriented* models.

The core elements of instructional design models. Perhaps the most common model used for creating instructional materials is the ADDIE model. This acronym stands for the 5 phases contained in the model (Analyze, Design, Develop, Implement, and Evaluate). In general, as described by Gustafson (2002b) most instructional development models include these five elements in their foundation and are variations of the ADDIE process. The Analysis phase might include conducting a need assessment, the gathering information about one's audience, identifying a set of performance deficiencies (such as errors being made by students), the tasks to be completed, or stating the project's overall goal. The output from Analysis phase is converted into performance objectives.

The Design phase includes writing measurable objectives and examining the content and objectives to decide on appropriate sequencing, media, and methods, which in turn specify learning activities required for the audience in order to meet the goals identified in the Analyze phase.

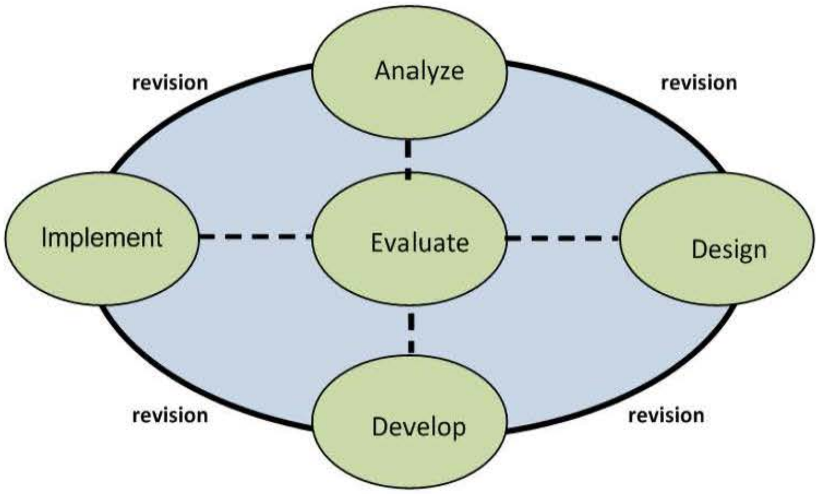

Figure 6. Core elements of instructional design -ADDIE

As the blueprint being created in the Design phase, it is converted into instructional materials and procedures in the Development phase. The materials and procedures are used to deliver the instruction for the learners and in the settings for which it was designed during the Implementation phase. During the Evaluation phase the learners and the instructional system are probed using formative and summative assessment to decide whether revisions are needed; in which case the process would be repeated with the next iteration of instruction. The iterative aspect of the model is represented by the lines running vertically, horizontally, and between each component, as depicted in Figure 6. Each major phase of the process is accompanied by some sort of formative evaluation to identify necessary revisions to the instruction. After Analysis, for example, are the descriptions of the audience and the learning needs accurate? After Design, are the objectives and methods judged appropriate by experts? After Development, does the prototype work in a small-scale tryout, or how can it be improved? After Implementation, did the entire intervention achieve its goal, or what remains to be done? This summative evaluation involves collecting data to assess the overall worth of the instruction (Gustafson & Branch, 2002b; Molenda, 2004). This final phase is vital for the instructional design team because it provides data used to alter and enhance the design.

Media selection models. Educators throughout the world face a complex and difficult task of choosing appropriate media to deliver instruction in particular learning environments. A number of media selection models were put forth to assist and provide selecting techniques.

According to Morrison, Ross, and Kemp (1994), there are three different approaches to media selection: (a) Selection based on what is readily available (b) Selection on the basis of what a teacher is most comfortable using (c) Selection on more objective basis whereby some guideline can be followed, so that selection can be justified in a non –subjective manner. Sugrue and Clark (2000) highlighted the absence of detailed information on how media are actually selected in the real world by real people and claim that important distinctions among media, media attributes, and instructional methods have been blurred.

Although some researchers claim that there is no direct causal connections and links between media and learning gain (Clark, 1983, 1994), there is no shortage of media selection models (Heidt, 1989; Reiser & Gagne, 1982; Romiszowski, 1988). Reiser and Gagne concluded their review of existing selection approaches as follows:

> In several of the models reviewed, selection criteria focus on media attributes (i.e., the physical capabilities of media), such as the ability to present sounds or depict motion. Other models, however, focus on the characteristics of the intended learners, the instructional setting, and the learning task. Proper identification of the media attributes necessary in a given situation depends on consideration of the latter set of factors. (1982, p. 510)

Heidt noted that none of the models offer easy and user-friendly instruments to assist in selection of media. He concludes his review of media selection models developed to date as follows:

> Research so far has not been successful in discovering how the factors commonly agreed upon as relevant should enter the selection process nor what the consequences of alternative media decisions really are. Because of the complexity of educational situations, the selection remains a matter or subjective good judgment based on the consideration of a large list of potentially relevant factors. (1989, p. 397)

Sugrue and Clark (2000) described a cognitive approach to media selection which involves selecting methods and media attributes before selecting media. They suggest a six-part model of the cognitive processes involved in learning in contrast to a more traditional two-stage process of media selection (first stage- selection of media candidates to match task, trainee, and instructional event characteristics, and second stage – involves selecting between media candidates based on practical consideration of cost, availability, and convenience) . Then, Sugrue and Clark describe how instructional methods can be selected to support each of the six processes. Next, they explain how media attributes can be matched to methods. Further, the authors propose guidelines for selecting media or mixes of media with attributes that will deliver various combinations of instructional support. Example of how their approach could be applied in the context of developing a multimedia instructional program is provided. Finally, they discuss potential future scenarios for both the contexts in which media selection decisions must be made, and the rules that might drive those decisions.

One of the advantages of this approach is that media might be selected even before instruction is designed and the pre-selected media can be reviewed to make sure that they possess all of the attributes that the design requires for implementation. If the initial choice is not capable of meeting the objectives of the instruction, then the selection can be modified or added.

So far, in this section of the literature review, the researcher has discussed media selection models without providing any definition for what media are. But from the context of the research discussed, it is clear that the discussion was about so-called educational media: text, graphics, audio, video, and computers (or computing).

There is another, broader meaning of media and the author of this study resorts to the help of Tony Bates (2011) to explain this meaning of media. He posits that media in this second meaning "refers to the industries or significant areas of human activity that are organized around particular technologies, for instance film and movies, television, publishing, and the Internet. Within these different media are particular ways of representing, organizing and communicating knowledge. Thus, for instance, within television there are different formats, such as news, documentaries, game shows, action programs, while in publishing there are novels, newspapers, comics, biographies, etc. Sometimes the formats overlap but even then there are symbol systems within a medium that distinguish it from other media". The researcher also adds to his list of media (in the second meaning) video games as another way to communicate and represent information. Bates further explains that this concept of media is much "softer and richer" than that of media-as-technology concept and harder to define.

In light of this discussion, the existing media selection models can help to progress only so far. For example, if a designer of a new instruction wants to use media to enhance students' learning, the existing media selection models can assist her, at least partially, in choosing appropriate media (movies, TV show, video games, or computer simulations). Some of the models focus on media attributes, such as ability to present symbols, produce sound, or depict motion. Other models focus more on learners' characteristics, the instructional settings, and the learning tasks. But most of these models are helpless in providing guidance as to how select media "within media": how one should choose the TV shows clips to introduce a certain topic for early learners? What sequence of the scenes from sci-fi movies to select and present to reinforce high school physics concepts? How one should select an appropriate level of a video game to assess knowledge about the Rome civilization?

The combined "recipe" based on existing models can be summarized according to Reiser and Gagne (1982) as follows: "After questions about the learners, setting, and task have been addressed, the necessary media attributes can be readily defined and the media possessing those capabilities can be identified. The designer can then proceed to select from among those media on the basis of such practical factors as cost and availability, unimpeded by doubts about instructional effectiveness" (page 510) . The question of how to proceed further is left unanswered.

Literature Review on Repurposing Popular Media

Researchers and educators around the world are realizing the importance of combining popular culture with education. For example, Koshi Dhingra (2003) stressed that it is important for educators to recognize that television-mediated understandings about the nature of science and scientists influence what students bring with them into the classroom. Introducing popular culture, including TV shows and films, into traditional classroom settings is a new and exciting way to maximize students' learning and engagement.

This section of the literature review will focus on investigation of the following questions:

- What research has been conducted regarding the repurposing of popular media, including film, television, and video games for instructional use?
- What trends have emerged over the course of such research?
- How have research results from these studies impacted the practice of utilizing popular media for educational purposes?

Reuse and the repurposing of popular media. The term repurposing refers to the changing of a learning resource or object initially created for a specific educational context, to a new educational context (or contexts) (Kaldoudi, Dovrolis, Konstantinidis, & Bamidis, 2011), and should be distinguished from reuse, which refers to the use of the same learning resources or objects without any changes (Meyer et al., 2006).

Learning objects may be categorized in a variety of ways including those that are highly complex and thus are likely to be used extensively on an intra-contextual and an inter-contextual basis (Wiley & Hanlis, 2002) and that a learning object is anything digital or non-digital with pedagogical value that supports learning (Friesen, 2001; Harman, 2005; IEEE, 2002; Quinn & Hobbs, 2000). Therefore, we can assert that learning objects include anything that has pedagogical value - digital or no-digital such as a case study, a film, a simulation, an audio, a video, an animation, a graphic image, a map, a book, or a discussion board so long as the object can be contextualized by individual learners. Hence, if teachers use movie or TV programs clips, or generic video games in their classrooms for educational purposes, we can identify this media as learning objects.

Repurposing can further be divided into (a) repurposing for reasons of localization translation to a different language, or minor changes to account for cultural differences, and (b) repurposing to incorporate significantly new content – e.g. taking an activity used in an English course, and adapting it for use in a mathematics course.

Another dimension of repurposing lies in changing the way the resource is used, rather than changing the resource itself – i.e. changing the learning design. So, a learning object that is reused without any change to its content or function, yet is used in a different way to that originally envisaged by its developer, has in a sense been repurposed. This type of repurposing happens more often than not when a learning object is reused as the researchers from the DART (Digital Anthropological Resources for Teaching) project state (Bond, Ingram, & Ryan, 2008).

Multimedia repurposing has been an area which received considerable attention by researchers. Steiger and colleagues (2003, September 14-17) have worked on an MPEG-based personalized multimedia content delivery system, while other researchers (El Saddik, Hossain, & Rahman, 2004, May 2-5; Hossain & El Saddik, 2007, November 24-27) have introduced a multimedia content repurposing framework using Web Services.

There can be a variety of situations where repurposing of educational content is desired. These situations, referred to as "repurposing contexts," can be of a pedagogical nature, a technical nature or both. They can broadly be distinguished into ten different categories (Kaldoudi et al., 2011; Protopsaltis, Panzoli, Dunwell, & Freitas, 2010, May 27-30) and include the following repurposing contexts: 1) in terms of the actual content; 2) to different languages; 3) to different cultures; 4) for different pedagogical approaches; 5) for different educational levels; 6) for different disciplines or professions; 7) to different content types; 8) for different content delivery media and/or technology; 9) to educational content from an initial content type that is not intended for education; and 10) for people with special needs.

For instance, a good example for the last repurposing context (for people with special needs) is the Digital Talking Books (DTB) framework, which supports the production of automatic generation of multimodal digital talking books from original raw materials (tapes and text), and provision of fundamental mechanisms to identify, extract, and store excerpts of digital spoken books, to enrich them with other media and to combine them into new perspectives, stories, or documents (Carriço, Guimarães, Duarte, Chambel, & Simões, 2003, June 23-27).

Repurposing video games. In 2003, a movement was started for using video games in teaching and training. This initiative, known as serious games, has changed the way that educators viewed instruction to meet the needs of the modern generation of students. Serious Games engage users in their pursuit and contribute to the achievement of purposes other than pure entertainment. Although video games have been around for over three decades, it has not been until recently that technology has allowed for the metamorphosis of video games into fascinating descriptive narratives and captivating storylines.

The Federation of American Scientists (FAS, 2006) called video games the next great discovery, as they offer a way to captivate students to the point that they will spend hours learning on their own time. As this report indicated there is a need for the federal government to drive the movement forward with both financial and political support. As the result of this drive, the games such as Immune Attack, Food Force, and Discover Babylon, just to name a few, were developed.

The use of educational games within lesson plans is an increasingly common practice for teachers and educational technologists. Games connect specific content and skills with a friendly environment where students are able to play, try, make mistakes and learn. Digital games and simulations have a number of features that make them advisable to be used in learning processes. They provide a good vehicle to establish social relationships and strengthen cognitive skills in the player. One solution for educators is integrating a game in a pedagogical structure through a link, without interaction and communication. The main advantage of this approach is its simplicity for teachers and instructional designers. The disadvantage is that the game is played as an isolated learning object without being an integral part of the learning design (Protopsaltis et al., 2011).

Another solution is repurposing the existing games with the game becoming an essential part in the lesson plan, opening up possibilities for adapting the learning flow on the basis of results and performance from the game. Considering the time, effort, resources, cost and complexity of developing serious games it is desirable that games can be repurposed effectively into educational practices and curricula. This includes updating, changing, enriching serious games to reflect new functionalities, amending to different pedagogies, technologies, representations, cultures, contexts and learners (Protopsaltis et al., 2011, October 3-5). Therefore, being able to repurpose game content reduces the need to constantly rebuild content, and offers potential to efficiently adapt serious games and game elements to meet the needs of wider audiences and application areas.

The area of games repurposing is still in its infancy and there are no exhaustive works addressing the issue. In one such study, Burgos, Tattersall and Koper (2007) describe the use and the repurposing of commercial games. They described two different approaches: one, where a game is used as an autonomous learning object disconnected from the learning flow, while in the other approach a game is fully integrated in the learning flow. The researchers took the generic game Caminatas (about learning Spanish) as a base and have re-purposed it. Originally, the game had twelve different section but the researchers used just a few of them to be repurposed into three very different sections which were fully integrated additional activity in the learning flow.

Other studies describe the potential of games or how off-the-shelf games can be used in the classroom (Gee, 2007; Prensky, 2001; Squire, 2001) Examples of generic games used for learning include the Sims, SimCity, Flight Simulator, Pac- Man, FIFA, SuperMario Bros, Civilization, Rayman and Diablo II (Dickey, 2005; Jenkins, Klopfer, Squire K., & Tan, 2003).

Another article (Protopsaltis et al., 2010, May 27-30) describes exploratory work towards identifying the key issues faced when repurposing serious games in order to enable their use and reuse in the same or different educational contexts. To address these issues, the authors propose a theoretical framework for the repurposing of serious games in medical education and in education in general. Two case studies based on the Climate Health Impact serious game were presented. These case studies demonstrated the ability to repurpose a serious game into new learning objects, covering two different paradigms of content repurposing - language and pedagogy.

Serious games are one of the most content-rich forms of educational media, often combining high fidelity visual and audio content, novel interaction paradigms, and diverse pedagogic approaches. A limited knowledge of an average educator about how games are designed and programmed is still a hindering factor for everyday repurposing of game content. Therefore, game developers should realize the increasing demand from educators who consider serious games content as a relevant source of educational material. In concert with educators, the role of researchers is thus to provide game developers with recommendations and frameworks that would enable repurposing of video games at the lowest cost.

Repurposing TV shows. When we watch a good TV program, feelings and emotions such as excitement, love, anger, laughter, relaxation, love, and whimsy are elicited. These emotions are often triggered by specific visual scenes, the actors' performance, or the background music. Can teachers repurpose popular TV programs and use them as an instructional tool so their students can experience the powerful cognitive and emotional impact they can provide? Ronald A. Berk (2009) lists twenty potential outcomes of using video clips in the classroom that include but are not limited to the following: they grab students' attention, generate interest, foster creativity, create memorable visual images, stimulate the flow of the ideas.

However, research on repurposing TV programs and using them as instructional tools is sparse. Some of the found studies concentrated in the mental and physical health fields in application to college level courses.

One such study (Wong, Saber, Ma, & Roberts, 2009) used popular television shows to teach their residents in a core internal medicine residency program about effective communication skills. They selected two excerpts from the television show *House* and one from *Gray's Anatomy* and featured them in conjunction with a brief didactic presentation of the Kalamazoo consensus statement (Makoul, 2001) on doctor-patient communication. To assess the efficacy of this approach a set of standardized questions were given to the residents once at the beginning and once at the completion of the session. Residents indicated that their understanding of an evidence-based model of effective communication and their comfort levels in applying such model in clinical practice increased significantly. The residents also reported that their comfort levels in three challenging clinical scenarios presented to them improved significantly.

The challenge of teaching good communication skills and psychotherapy to medical students was addressed in another study (McNeilly & Wengel, 2001) through development of a clerkship seminar that stressed the practical application of psychotherapeutic techniques to the difficult and/or psychiatric patient. Clinical vignettes from television programs such as "ER" were used to illustrate encounters with extremely emotional or personality-disordered patients.

Getting students to understand the economic way of thinking might be the most difficult aspect of a teaching economist's job. The counterintuitive nature of economics often makes it difficult to get the average student to think "like an economist." The need to keep students engaged and interested is essential when teaching economic principles; therefore, interdisciplinary approaches to engaging students are becoming increasingly common. Joshua Hall (2005) further extended this interdisciplinary approach to economic education by providing examples from the animated television show *The Simpsons* and used it to stimulate student discussion and engagement in an introductory course in microeconomics. The bulk of this paper describes scenes from *The Simpsons* that illustrate basic economic concepts. *The Simpsons* provides many examples of business failures (mostly Homer's). These failures provide a good opportunity to discuss what makes successful entrepreneurs so special.

A sprinkling of repurposing applications of TV programs in K-12 educational system has appeared in some subject areas, including mathematics (Chen, Hoelscher, & Ellis, 1988), school physiology (Alvarado & Maskiewicz, 2011), English literature (Hobbs, 1998) , and social studies and foreign language (Cambre, 1992).

Chen et al (1988) investigated whether a children's television series "Square One" on mathematics, produced primarily for an at-home use, could be repurposed for classroom use. Segments were selected from this PBS series and edited into 30 videocassettes organized by curriculum topics. It was found that repurposed TV show scenes were useful motivational and instructional resources, especially in demonstrating connections between mathematics ideas and real - world situations.

Another researcher (Hobbs, 1998) has employed an activity in her English literature class where students compared an episode of *The Simpsons* to some speeches and essays of Mark Twain, including selected passages from *Life as I Find It, Roughing It, The Gilded Age, A Connecticut Yankee,* and *The Prince and the Pauper*. It was an instructional strategy which invited students to consider the categorization of texts into "high" and "low" culture, and helped students build media literacy skills by applying tools of textual analysis to a popular program. Such works can generate some remarkable, vigorous, and sophisticated reasoning, rich conversations, and dynamic writing from young people (Hobbs, 1998).

Other researchers (Alvarado & Maskiewicz, 2011) were interested in finding out whether high-school students' understanding of human physiology could be improved through the use of multimedia resources, specifically through the use of popular television. The premise of this mixed-methods study, conducted over a traditional school year in a general biology class at a lower-socioeconomic urban public high school in southern California, was to capitalize on student interest in multimedia so that it becomes a vehicle for helping science learners develop understanding of the nervous system and the immune system. Using integrated media in high school biology classes, they were able to show significant achievement gains in physiological content knowledge over the course of the entire academic year. Episodes of Fox's popular medical drama *House, M.D.* were incorporated into the curricula during instructional units on two body systems: the nervous system and the immune system.

The results of the abovementioned studies are consistent with those of education researchers Harwood and McMahon, who concluded that integrated media is "an instructional tool that can be used effectively to bring the often abstract, distant worlds of science into close focus and within the personal meaningful realm of each individual student" (1997, p. 617).

Repurposing film. Educators have long used popular film in classes in order to demonstrate realistic and real-world connections to concepts. Roberts and colleagues write that when,

> used effectively, film can take students to the higher levels of application, analysis, synthesis, and evaluation as they apply theories to life on the screen, analyze characters, create new scenarios or endings to films, and evaluate the quality of a film's presentation of relevant concepts. (2003, p. 2)

Feature films have been successfully used to teach psychiatry, counseling and family therapy (J. Higgins & Dermer, 2001; Toman & Rak, 2000; Zerby, 2005) to both undergraduate and graduate students. For example, Zerby (2005) used the science fiction film *Invaders from Mars* to teach principles of child development; clinical features of separation anxiety and nightmares; and clinical interventions, including child psychotherapy, child protective issues, and crisis management.

Several studies were found that described using films' clips to teach nursing. Higgins and Lantz (1997) described using *The Lion King* to teach developmental concepts in a pediatric nursing course, while Masters (2005) evaluated students' perception of viewing feature films as an alternative to some clinical time in a psychiatric mental health course.

Films have been used to teach biology and chemistry courses. For example, Pryor (2008) referred to the feedback of his non-major biology students about the use of movie clips in his introductory biology classes. In his courses, 100% of students filling out anonymous questionnaires at the end of the semester found the use of examples from films interesting, and 97% found the examples helpful in learning and remembering the material. This approach of using films' clips as teaching tool has tested favorably with other biology instructors, such as Borgwald and Schreiner (1994) and Edwards (1997). Edwards provides an excellent summary of this approach: "Pointing out the role of biology in such familiar and popular culture phenomena has proven very effective in reaching students who might otherwise have been intimidated by or prejudiced against science" (p. 33).

Films have been used to teach a variety of other college subjects. Some of the most interesting examples are the following. Asma (1999) tried to convey philosophical ideas to his students by using movies - a medium to which they are already attracted. He used films together with some traditional philosophical texts and structured the course by thematic sections, such as "The Labyrinth of Skepticism," "Problems of Alienation," and "Freedom and Responsibility. Asma also used Martin Scorsese's *Goodfella*s as a gateway into Plato's argument, in *The Republic*, that a life of justice is preferable to a life of injustice.

Seferoglu (2008) integrated feature films in oral communication advanced English classes as foreign language (EFL). A total of 29 students being trained as teachers of English participated in the study. All participants unanimously agreed that through films they had the opportunity to learn about how people initiate and sustain a conversational exchange, and how they negotiate meaning; types of exclamation and filling expressions; colloquial English in real-life contexts, and non-verbal communication.

After reviewing many reports on usage of film for teaching on college level, the researcher feels that one observation is noteworthy to mention. Although using and repurposing films to teach was considered very effective by researchers and was well accepted by students, evaluations for the most part were based on anecdotal evidence of the effectiveness of using film to teach courses and on students' responses to several items on course evaluations.

Repurposing film in K-12 setting. Since Hollywood movies are a big part of youth popular culture, it is not surprising that many teachers are eager to bring them into the history K-12 classroom to motivate student interest. But there is a certain "danger" since, unlike documentary films which are usually made with educational purposes, Hollywood movies are produced as entertainment products. Therefore, using history movies in the classroom requires special attention to the knowledge about their historical content and credibility of their connections between the past and our present world.

Many students tend to take movies' accounts of the past at face value without considering their credibility. As a result, students can get confused about the boundaries between fiction and historical facts and may draw naıve conclusions about some historical topics (Meyerson &

Paxton, 2007). Tolpin (2002) observes that many history movies get around concerns about accuracy through “faction”—blending historical evidence into an entertaining fictional story. Written accounts of history are allowed to speculate and guess about uncertainties in the past. Filmmakers do not have this luxury and must present complete and convincing interpretations on the screen. Instead, Tolpin argues, “movies about the past often provide an emotional hook that pulls audience interest toward a study of the subject. . . . Movies give audiences a feeling for life in a distant time and place” (2007, p. 126).

Marcus’s (2005, 2007) research demonstrates why teachers need expertise in using film in the context of active thinking, otherwise movies in the classroom tend to be shown passively and without critical thinking on the part of students. Because students are likely to encounter history movies long after their formal schooling, a useful benefit of teaching with film is to provide students with the skills and knowledge to analyze, interpret, and evaluate the messages in historically themed films—what Marcus labels “historical film literacy.”

As the researcher moved to other school subjects the accounts of the films’ use and repurposing in classroom became extremely scattered.

One experimental study (di Palma, 2009) with twenty-eight students aged thirteen years had the aim of repurposing clips from famous feature films to promote active geographical learning. In this experiment, the researcher dealt with the theme of terrestrial environments, a key topic that lies on the boundary between geography, natural sciences, and ecology. Her proposal to the class was to imagine a trip to faraway places and create a concept map of “Journeys in faraway countries”. As the second step, students were asked to bring a videotape with a film clip—two or three minutes—illustrating, for example, a rain forest or a hot desert.

A finished collection of more than fifty film clips included the images of tundra (*The Grinch*), damp savanna (*Out of Africa*), glaciers and polar deserts (*The Lord of the Rings*), hot desert (*The Mummy*), and many more landscapes. Each of the seven groups that the researcher formed were to choose seven clips, which they then used to develop a new story, located in at least three different habitats and create their own movies. The results of the post-test showed that students acquired a good knowledge of terrestrial environments as was documented by a comparison of pre-test and posttest results.

A search for "films, science classroom" on Google elicited hundreds of websites listing movies and lesson plans that can be used at different grade levels to cover a spectrum of scientific concepts. Several books by prominent scientists lead readers on the voyages to the world of physics, chemistry, and biology to find out what Hollywood creators got right-and -wrong about science in the movies (Dubeck, Moshier, & Boss, 1994; Griep & Mikasen, 2009; Perkowitz, 2007). Yet, there are no experimental studies that would implement these fruitful ideas and document the results about students' learning achievements.

Thomas Edison once said "I believe that the motion picture is destined to revolutionize our educational system and that in a few years it will supplant largely, if not entirely, the use of books." His prediction has yet to be realized. Feature film as a teaching tool in the modern classrooms continues to gain prominence as teachers' use of film expands. However, the potential benefits of film will only be realized if teachers have pre- service and in-service training about the use of film. Unfortunately, the teachers who responded, for example, in one study (Marcus & Stoddard, 2007) reported that the topic of using feature film to teach history (or any other school subject) was rarely included in the curriculum of their teacher education program.

Conclusion. Repurposing popular media, including film, television, and games is gaining more popularity amongst educators. However, the empirical research in many areas is sparse, especially in the field of K-12 mathematics and science. Media repurposing is not an easy task and sometimes it involves changing the content or modification of the original pedagogical intent, or in some cases the development of new pedagogical approaches.

The necessary part of the repurposing process is that teachers take a film, or a TV program, or a video game and make it their own. The original use of the activity will work as a "cognitive catalyst" for the teacher as they work through and shape it into a new instantiation (Bond et al., 2008).

Review of Literature on Learning Theories and Characteristics of the New Generation of Learners

Learning theories provide theoretical foundations for instructional designers for developing and planning instruction. As Mergel (1998) posits, designers must understand the strengths and weaknesses of each learning theory to optimize their use in appropriate instructional design strategies. The roots of instructional theory can be traced back to the dawn of the 20th century when psychologists tried to develop a connection between the science of psychology and the practical application of learning theory in educational settings. As explained by Robert Tennyson (2005), two theorists of particular importance were John Dewey (Dewey, 1910, 2006), who envisioned a special linking science between learning theory and educational practice, and Edward Thorndike (1923), who investigated principles of learning that could be directly applied to the teaching process (i.e., the laws of effect and exercise). Thorndike developed a body of instructional design principles that included task analysis and teaching methods based on his research findings and student evaluation methods (Tennyson, 2005). Instructional designers must understand the strengths and weaknesses of each learning theories to optimize their use in appropriate instructional design strategy (Karagiorgi & Symeou, 2005)

Behaviorist learning theory. Throughout most of the 1960s, instructional design continued to be based on behaviorist learning theories and instructional theories were defined in corresponding terms as "small, incremental steps sequenced to link information in a logical order; active learner participation in responding to instructional stimuli with immediate feedback as a positive reinforcer. Learner progress is based on successful attainment of defined behavioral objectives" (Skinner, 1954, p. 88).

A major goal of instructional design focused on methods of task analysis and the development of behavioral objectives for learning. The goals of the task analysis were 1) to identify small tasks or sub-skills that the learner needed to acquire, 2) prepare specific behavioral objectives that would lead to the acquisition of those sub-skills, and 3) sequence sub-skill acquisition in the order that would lead to successful learning outcomes. Individual differences of the learners in the behavioral approach were accounted by manipulating the learning environment to accommodate student differences. For example, learners with a high aptitude would receive an instructional strategy that would be different from that for students with a low aptitude. As described by Winn (1990), behaviorism attempts to prescribe strategies that are most useful for building stimulus-response associations, including the use of cues, practice, and reinforcement.

Paul Saettler in his book *The Evolution of American Educational Technology* identified six areas that demonstrate the impact of behaviorism on IDT field: the behavioral objectives movement; the teaching machine phase; the programmed instruction movement; individualized instructional approaches, computer-assisted learning and the systems approach to instruction (Saettler, 1990).

Many major assumptions of behaviorism are embedded in instructional design practices including Gagne's events of instruction, the use of measurable behavioral objectives popularized by Robert Mager (1962), and Dick and Carey instructional design model.

As stated by Sutton (2003), there are many aspects of behaviorism that are positive and that have led to the development of important instructional technologies. Examples of behaviorism in current trends are instructional software and computer-assisted instruction (Weegar & Pacis, 2012, January 2-4). As explained by Shield (2000), behaviorist principles are often used in drill and practice on-line tutorials that are designed to reward students "through an encouraging comment before moving on to the next learning objective". Shield explains that "the student's mastering of basic technological terms, descriptions of components, and understanding of theory behind technical processes can be achieved through structured programs delivered through CD-ROMs or similar media" (p.74). Shields further posits that,

> the computer games that are so highly addictive to teenagers are perfect examples of learning behavior being progressively rewarded as each level of the game is mastered. This learning is not restricted to the cognitive field in which the game is mastered but also in the area of psychomotor skills when the reflexes of learners are constantly refined to produce ever faster reactions to visual stimuli. (2000, p.74)

Shield concludes by stating that behaviorist practices are still relevant in today's digitized world.

In the late 1960's, learning theory began to make a gradual shift from behavioral paradigm to a theory that is based on cognitive approach to learning. Accordingly, the interest in instruction based on behaviorist paradigm declined as well. This happened due, at least partially, to the fact that research findings revealed that the programmed materials were often no more effective than conventional materials and that students often found the materials to be uninteresting and boring. In addition, many of the principles of learning proposed by Skinner and other behaviorists were found to be untrue, especially for the complex learning tasks required in the real classroom environment. Research was also contradicting on the role of those behavioral principles such as feedback, rewards, sequencing, and definition of objectives played in the learning process (Tennyson, 2005).

Cognitivist learning theory. Although cognitive psychology emerged in the late 1950s and began to take over as the dominant theory of learning, it wasn't until the late 1970s that cognitive science began to have its influence on instructional design. As this shift from behaviorist paradigm to constructivist approach happened, practitioners in the field of instructional design rejected many of the IDT's traditional assumptions in favor of a new set of assumptions about learning drawn from the findings of the cognitive sciences. These findings emphasized cognitive processes such as thinking, problem solving, concept formation, and information processing (Snelbecker, 1987).

Cognitive theories emphasize making knowledge meaningful and helping learners organize and relate new information to existing knowledge in memory. Specific cognitivist principles or assumptions had direct relevance to instructional design (Ertmer & Newby, 1993). For example, possible ID application for the active involvement of the learner in the learning process would be learner control and metacognitive training (e.g. self-planning, monitoring, and revising techniques. Possible ID application for creation of learning environments that encourage students to make connections would be recall of prerequisite skills, use of relevant examples (Ertmer & Newby, 1993).

Many of the instructional strategies utilized previously by the proponents of behaviorism are supported and utilized by cognitivists, although for different reasons. For example, behaviorists use feedback as reinforcement to modify behavior in the desired direction, while cognitivists use feedback (knowledge of results) to guide and support accurate mental connections (Thompson, Simonson, & Hargrave, 1992).

Similarly, learner and task analysis are critical for both approaches but the reasons are differ again. The design models that had been developed in the behaviorist tradition were not simply tossed out, but instead the "task analysis" and "learner analysis" parts of the models were embellished. The new models addressed component processes of learning such as knowledge coding and representation, information storage and retrieval as well as the incorporation and integration of new knowledge with previous information (Saettler, 1990). Because cognitivism and behaviorism are both governed by an objective view of the nature of knowledge and what it means to know something, the transition from behavioral instructional design principles to those of a cognitive approach was not that drastic. The goal of instruction remained the communication or transfer of knowledge to learners in the most efficient, effective manner possible (Bednar, Cunningham, Duffy, & Perry, 1992) .

For example, the breaking down of a task into small steps works for a behaviorist who is trying to find the most efficient and effective method of shaping a learner's behavior. The cognitive scientist would analyze a task, break it down into smaller chunks and use that information to develop instruction that moves from simple to complex concepts building on prior schema (Ertmer & Newby, 1993).

The influence of cognitive science in instructional design is evidenced by the use of advance organizers, mnemonic devices, metaphors, chunking into meaningful parts and the careful organization of instructional materials from simple to complex (Mergel, 1998).

Constructivist learning theory. The learning theory of Constructivism evolved from the extensive study of cognitive development and has roots in the works of Piaget, Bruner, and Vygotsky. Their study of how thinking develops with age provided the foundation for the psychological theory of constructivism. Constructivists believe that people develop knowledge through active participation in their learning and equates learning with creating meaning from experience (Bednar et al., 1992) However, Piaget believed that cognitive development was a product of the mind "achieved through observation and experimentation whereas Vygotsky viewed it as a social process, achieved through interaction with more knowledgeable members of the culture" (Remmel, 2008, p. 80). Piaget's theory was comprised of two major elements "ages" and "stages." According to Piaget, "these elements help to predict what children can and cannot understand at different ages." (Remmel, 2008, p. 80).

According to constructivism, knowledge cannot be imposed or transferred intact from the mind of one knower to the mind of another. Therefore, learning and teaching cannot be synonymous: we can teach, even well, without having students learn (Karagiorgi & Symeou, 2005).

It is important to understand that the term "Constructivism" is an umbrella term for various types of constructivism such as radical, social, physical, evolutionary, post-modern and information-processing and "there are as many varieties of constructivism as there are researchers" (Ernest, 1995, p. 459). In general, two loosely associated groups are identified: first, radical constructivists who insist that every reality is unique to the individual and second, non-radical or social or moderate constructivists who believe that shared reality grows out of social constraints placed on the constructive process of the individual (Karagiorgi & Symeou, 2005).

A number of theorists have discussed the ways in which constructivist principles and assumptions influence instructional design practice and have suggested several instructional design models. For example, Jonassen (1999) discussed a model for designing constructivist learning environments (CLE). The model conceives of a problem, question, or project as the focus of the environment, with various interpretative and intellectual support systems surrounding it. Lebow (1993) summarized the implications of constructivism for instructional systems design (ISD) as five principles that integrate the affective and cognitive domains of learning.

Willis (1995) offered the Constructivist-Interpretivist Instructional Design Model, which has the following characteristics: The design process is recursive, non-linear, and sometimes chaotic; Planning is organic, developmental, reflective, and collaborative; Objectives emerge from design and development work; General ID experts do not exist; Instruction emphasizes learning in meaningful contexts (the goal is personal understanding within meaningful contexts); Formative evaluation is critical; Subjective data may be the most valuable. The constructivist design principles outlined in this ID model can lead to a variety of learning environments. Examples of these constructivist learning environments include situating cognition in real-world contexts, cognitive flexible learning, collaborative learning, etc.

Kumar (2006) developed a constructivism oriented instructional framework to bridge the gap between theory and practice. This framework suggested a repertoire of heuristic instructional strategies that facilitated students' independent construction of various classes of scientific knowledge.

Many designers do not fully embrace constructivist principles to guide them in developing instructions as there are many areas of conflict. As cited by Karagiogi & Symeou (2005), Merrill (1991) considered constructivist interventions as labor intensive and Dick (1992) concludes that such interventions are costly to develop, require technology to implement and are difficult to evaluate.

However, those designers and practitioners who embraced constructivism, implement many educational strategies that can be described as constructivist in nature. Some examples include situations where students learn by discovering on their own, or students collaborating with teachers and peers while learning through this interaction. Hypermedia and multimedia are examples of online instructional approaches that are more constructivists in nature and allow more learner control than alternative strategies. Another important strategy is the presentation of multiple and alternative views to learners. A rich learning environment encourages multiple learning styles and multiple representations of knowledge from different conceptual and case perspectives (Kafai & Resnick, 1996).

The application of constructivism to instructional design has certain advantages such as more meaningful learning outcomes, more independent problem-solving capability and more flexibility in both design and instruction activities . However, the translation of constructivism into instructional design practice holds many challenges for designers.

The trend in instructional design moved toward a synthesis of elements of the various instructional theories and advancements from cognitive science and educational technology. The notion of developing a single, most effective approach for all instructional situations was replaced by attempts to find the best approaches to achieve specific, well-defined performance outcomes in terms of knowledge and cognitive processes (Tennyson, 2005).

Characteristics of a new generation of learners. In previous sections of this part of the literature review, an evolution of learning theories and the influence of new paradigms on the instructional design practices were discussed. Yet, there is another factor to the equation that describes teaching and learning process, and this factor represents the learners.

We were told that there is a new generation of learners that was born after the digital technologies have emerged and became embedded in every aspect of our lives. Some researchers claim that new approaches to learning are needed because this new generation of learners requires rapid access, prompt feedback, and quick rewards; they also reject linier thinking and demonstrate a novel capacity of multi-tasking.

For example, Prensky (2001) states that there is mounting evidence that digital generation children's brains are changing to accommodate the new technologies with which they spend so much time. Not only are the "digital natives" better at spreading their attention over a wide range of events, as Green and Bavelier report (2003); but they are better as well at multitasking and parallel processing, taking in information and making decisions quickly, understanding multimedia, and collaborating over networks. What attracts children to today's popular media , such as video and computer games is neither the game's violence, nor even their subject matter, but rather the learning the games provide because children love to learn when it is not forced upon them (Prensky, 2001).

The argument that the new generation of learners have a natural aptitude and high skills when using modern technologies still persist, even though multiple empirical and theoretical studies challenged this view and provided critical response to this argument (Bennett, Maton, & Kervin, 2008; C. Jones, Ramanau, Cross, & Healing, 2010; Kennedy, Judd, Churchward, Gray, & Krause, 2008). For example, Bennet and his team claim that there is some kind of an academic form of "moral panic" that is supported by the claim that "there is a distinctive new generation of students in possession of sophisticated technology skills and with learning preferences for which education is not equipped to support" (Bennett et al., 2008, p. 783).

Kvavik (2005) found that undergraduate students had basic office computing skills, were frequent users of email and instant messaging and surf the Internet, but that these high levels of use and skill did not lead on either to a preference for increased use of technology in the classroom or adequate skills in using these skills for academic activities.

Other researchers list unfavorable characteristics of this generation such as lack of critical thinking skills and unrealistic expectations, as well as their desire to spend less time on tasks and reach success with little effort (Monaco & Martin, 2007).

It is clear that further research is required to investigate the young people's relationships with technology, their novel skillsets, and academic capacities which might be more complex and more dimensional than the digital characterization suggests.

Review of Literature on Integration

Instructional design models do not often appear to take a multidisciplinary approach; thus, often omitting the most effective and innovative options for new creative learning environments. The term "integrated" or "multidisciplinary" approach to instruction has many different, sometimes conflicting, meanings as discussed below. Integrating content from various subjects around themes and making these themes relevant to children—while also addressing state-mandated academic standards—requires a new model or enhancements of existing models for designing instruction.

The purpose of this section of literature review is to examine relevant literature, ranging in publication date from 1989 to 2012, and report how current research supports an integrated approach in designing instructions. Having identified a body of appropriate literature, the researcher kept in mind four questions that guided her “interrogation”: (a) What individual subjects/disciplines were used for integration? (b) What terms are used to describe interaction between the subjects? (c) What approaches have been used to enable interaction between various subjects? And, finally, (d) What rationales are presented for justifying interaction between these subjects?

Definitions and terms. As mentioned before, very early in the examination of the related literature, the researcher found out, that despite a plethora of terms, there is no universally accepted set of terminology to describe the nature and extent of interaction between school subjects. As Czerniak, Weber, Sandmann, and Ahern (1999) stated, “ambiguity is evident in the sheer number of words used to describe integration: interdisciplinary, multidisciplinary, trans-disciplinary, thematic, integrated, connected, nested, sequenced, shared, webbed, threaded, immersed, networked, blended, unified, coordinated, and fused” (p. 422). Often authors use the same term differently, or use terms such as “integrated”, “interdisciplinary”, and “thematic” synonymously. Moreover, no formal definition is provided by authors, so their understanding of terms resides implicitly in the model used to elaborate the dynamic of the relationship between subjects. As it became clear from the literature review, the lack of a clear definition of terms hinders a valid and reliable comparison between research studies.

In the areas of mathematics and science, "integration" is the most commonly used term. Beane (1995) who is a strong supporter of integration, used this term to describe learning experience that "transcends subject area and disciplinary identifications". He further explains that, "the goal is integrative activities that use knowledge without regard for subject or discipline lines" (p. 619). Barlex and Pitt (2000) used three terms (co-ordination, collaboration, and integration) to distinguish three possible relationships between two subjects in schools. According to the authors, the coordinated curriculum would involve teachers in each subject scheduling related topics in their respective courses. Collaboration requires sharing some activities between the courses. Integration combines two disciplines into a single course.

Applebee, Burroughs, and Cruz (2000) describe approaches to "interdisciplinary" teaching along a continuum ranging from correlated knowledge (characterized by related concepts), through shared knowledge (characterized by overlapping concepts and emergent patterns), to reconstructed knowledge (characterized by the elimination of disciplinary boundaries).

Fogarty (1992) presented ten models of integration that might occur in the curriculum. These ten models present ways along the continuum to accomplish various levels of integration. The author grouped these ten models into three sets: (a) within single disciplines - fragmented, connected, and nested, (b) across several disciplines – sequenced, shared, webbed, threaded, and integrated, and (c) within and across learners- immersed and networked. Drake (2007) is critical of Fogarty's models, since the components of the third set "was not integration because pupils experienced connections during independent studies" (p. 27) and the elements of the other two sets did not match her team's experience of trying to develop a full-blown curriculum. In summary, the author concluded that, "the 10 positions described parts within a whole" (p. 27).

Lenoir, Larose, and Geoffroy (2000) discuss four types of practices that emerged from several studies of primary teachers in Quebec over a ten-year period. These four types of practices constitute the polar extremes of two crossed continua. The *x*-axis represents the degree of fusion or dispersion among subject areas, the *y*-axis represents the intensity of relations from dominance to the absence of relations among subject areas.

At the first pole of the x-axis is the eclectic approach where teaching "consists of the transmission of disconnected and decontextualized heterogeneous elements from various subject areas regrouped without predetermining their structuring and insuring their pertinence, all in the name of integrative practices" (p. 96).

The second pole of the first continuum- the holistic approach. As the authors explain, this approach represents,

> an anti-disciplinary attitude, leading to the exclusion or trivialization of all reference to disciplinary conceptual structure and limiting the search for answers to daily life practices. Claiming the necessity of a holistic, global approach to human life in the name of daily realism and of the intellectual functional mode of childhood, this approach, pushed to its extreme, leads to the fusion of the different learning objectives into a blurred whole. (Lenoir, Larose, & Geoffroy, 2000, p. 98)

It is well known that many teachers adopt this thematic approach for pragmatic and organizational motives.

Lenoir et al. (2000) further explain that the first pole of y-axis represents the pseudo-interdisciplinary approach which is the most often used by primary teachers in the early grades. In this approach "the identification of a theme serves as a pretext and a thread of continuity for compartmentalized teaching of selected school subject areas" (p. 100). A good example for this learning scenario will be a lesson in social studies where the topic of Greece democracy becomes the trigger for the reading of Greece legends. The danger here is the belief that this approach is both interdisciplinary and integrating. According to Lenoir et al., in similar cases, the social sciences are reduced to playing a role of figuration. They serve as a triggering device; it is, therefore, only "a pretext for the pursuit of learning objectives in language arts. The only integration existing here is a risk of disintegration of the social sciences by making them disappear at the level of learning. Only appearances remain!" (p. 100).

Lastly, at the fourth pole , there is a hegemonic approach in teaching that "rests upon the model of the subject area deemed the most important, removing the specifics of the other subject areas and reducing them to a state of servility or of pretext" (p. 102).

In summary, Lenoir et al. (2000) recommend that school inter - disciplinarity, rather than leaning towards one or the other of the four polar extremes, should be situated at the crossroads of the two continua.

As many studies revealed, although teachers have good intentions and goals when they plan their interdisciplinary lessons, two major problems plague these practices (Jacobs, 1989). The author called the first problem "the Potpourri problem". As he explains, "many units become a sampling of knowledge from each discipline. If the subject is Ancient Egypt, there will be a bit of history about Ancient Egypt, a bit of literature, a bit of the arts, and so forth". This approach lacks the focus. Jacobs called the second problem 'The Polarity Problem" and explains that "teachers feel highly territorial about their subjects and are threatened as new views of their subject are promoted. There is a need for both interdisciplinary and discipline-field perspectives in design" (p. 2).

This brief review of literature shows that despite the plethora of discussion about the nature of integration, there are still different sets of terms and further clarification is still needed. Planning an interdisciplinary lesson is a challenging endeavor, and as Pang and Good (2000) suggest "blurring the boundaries between subjects may be "one of the most daunting tasks educators face" (p. 78).

Rationale and support for curriculum integration. A wide range of professional bodies, including government and subject associations, continue to support the integration of subjects and believe that there is value in and a need for interdisciplinary instructional approaches (National Council for the Social Studies, 2010; National Council of Teachers of English, 1996; National Council of Teachers of Mathematics, 2000; National Science Teachers Association, 2013)

Collectively, these organizations have met to establish guidelines for integration and some have even insisted that school schedules be adjusted to increase opportunities for content integration. The National Research Council's book *How people learn: Brain, mind, experience, and school* (Bransford, Brown, & Cocking, 1999) supports a shift away from traditional curricula that "often fail to help students" learn their way around" a discipline ", and toward the learning environments that assist students "to understand an overall picture that will ensure the development of integrated knowledge structures and information" (p. 139).

Over the years, several other reasons intensified the interest in and need for curriculum integration. Heidi Jacobs (1989) described three the most important of these reasons. As she explains, knowledge is growing at exponential proportions in all fields of study, forcing the remarkable degree of specialization that has resulted from research and practice. This growth puts additional burden on curriculum. The curriculum planner must wrestle not only with what should be taught but what can be eliminated from the curriculum. There is a need to rethink the ways to select the various areas of study. Knowledge will not stop growing, so integrated and multidisciplinary approach to curriculum is one solution to this (Jacobs, 1989).

Another reason is fragmented schedules when every 40 minutes students go to another class, with another teacher, to sit around another set of classmates to learn another school subject. Teachers struggle to plan their lessons to fit a limited time blocks rather than the needs of their students.

The third reason for the need of integrated curriculum is among the most difficult - the relevance of curriculum. As Jacobs explains,

> the relevancy issue also strikes a deeper chord. Only in school do we have 43 minutes of math and 43 minutes of English and 43 minutes of science. Outside of school, we deal with problems and concerns in a flow of time that is not divided into knowledge fields. We get up in the morning and confront the whole of our lives. It is here that relevancy comes into play. It is not that schools should avoid dealing with specific disciplines; rather, they also

> need to create learning experiences that periodically demonstrate the relationship of the disciplines, thus heightening their relevancy. There is a need to actively show students how different subject areas influence their lives and it is critical that students see the strength of each discipline perspective in a connected way. (1989, p. 4)

Therefore, as the author stated, the integrated curriculum attempts should not be seen as an interesting diversion but as a more effective means of presenting the curriculum, regardless what school subject is being taught. The curriculum becomes more relevant when there are connections between subjects rather than strict isolation.

Those who support curriculum integration also claim that research in psychology and human development support this approach. For example, Brooks and Brooks (1993), in defining constructivism, noted that deep understanding is constructed when students make connections between prior knowledge and new experiences; therefore, meaningful learning occurs when students see connections among ideas. Thematic teaching is supported by brain research (Cohen, 1995), as well as research suggesting that people process information through patterns and connections rather than through fragmented bits and pieces of information (Beane, 1996).

Paucity of empirical evidence. The review of relevant literature has revealed another important issue such as a paucity of empirical evidence that demonstrates the effect of interaction on students' learning. The evidence in support of an integrated approach is mixed. George (1996) identified at least thirteen benefits typically claimed for integrated instruction that are not supported by research including increased opportunities for problem solving, greater knowledge retention, learning in greater depth, and student involvement with curriculum planning. A literature review by St. Clair and Hough (1992) of previous studies regarding the benefits of curriculum integration did not show this practice to be any more effective than traditional one. However, the authors of this review concluded that interdisciplinary curricular and instruction holds promises by making the subject matter relevant to real life and thus engaging students in the learning process.

There are other studies that have shown integrated instruction to have a positive impact on student achievement scores (Stevenson & Carr, 1993; Vars, 1991). St. Clair and Hough (1992) suggested the need for additional studies, yet little has been done since then.

Among the studies that have been done to show a positive impact of integration, many are related to integration of mathematics and science. This is probably due to the fact that there is a long history of efforts to link these two disciplines as they typically viewed as logically connected (Berlin & Lee, 2005; McBride & Silverman, 1991; Pang & Good, 2000). Some of these studies have shown that integrating mathematics and science has a positive impact on student attitudes, motivation to learn mathematic sand science, and academic achievement (Bragaw, Bragaw, & Smith, 1995; Guthrie, Wigfield, & VonSecker, 2000; Hurley, 2001). Hurley (2001) provided some quantitative evidence in support of an integrated instructional approach for mathematics and science in her review of 31studies but, as previously with Czerniak et al. (1999), also found that multiple forms of integration were being used.

In addition to abovementioned challenges, there are other significant issues that hinder implementation of integrated instruction. These issues include classroom management, utilization of integrated instructional materials, teacher content knowledge gaps, and time constraints (Frykholm & Glasson, 2005; McBride & Silverman, 1991; van Driel, Beijaard, & Verloop, 2001).

The recent study by Stinson, Harkness, Meyer, and Stallworth (2009) was designed to learn more from teachers about the kinds of instructional examples teachers think reflect integration as well as how teachers tend to characterize integration. In this research study, middle grades science and mathematics teachers were surveyed to explore their understandings about mathematics and science integration. Teachers were asked to reflect on scenarios describing integrated mathematics and science lessons as well as provide their own examples of lessons they had taught in an integrated fashion. Each scenario "loosely mirrored" one of the five types of mathematics and science integration models, identified by Davison, Miller, and Metheny (1995): discipline specific (two or more branches of one discipline), content specific (choosing one existing objective from mathematics and one from science), process specific (using real-life activities), methodological (using methods as the medium of integration) and thematic (theme becomes a medium with which all disciplines interact).

The major finding of this study was a questionable content knowledge or understanding of the scenario by teachers. As explained further, having deeper disciplinary knowledge seems to be, for some teachers, a barrier to an interdisciplinary approach. The results of this study also support suggestions made by other researchers: "if mathematics and science integration is a desired practice in schools then teachers must have a strong sense of what it means to make this happen" (Davison et al., 1995, p. 159).

Chapter 3: Research Methodology

The design and development of instructional products and programs is considered by many to be the heart of the instructional design and technology (IDT) field (Richey & Klein, 2007). Over the past five decades, "many scholars have called for research to strengthen the fundamental knowledge base of the IDT field" (Richey & Klein, 2007, p. 2). This study used a design and developmental research approach to create a framework for incorporating the repurposing of popular media into existing instructional models for enhancing mathematics and science instruction. This framework is based upon the identification of specific theoretical components of four constructs (Instructional models, repurposing of popular media, learning theories and new generation learners' characteristics, and multidisciplinary/integrated approach to instruction) operationalized in the framework. In addition, a prototype module that utilizes the repurposing of popular media has been developed. The implications of this research will serve to provide guidance for instructional designers, educators, teachers, and other practitioners. For the framework's development and validation this study used the procedures identified and described by Richey and Klein's (2007) (please see Appendix A).

Research Design: Design and Development Research

Design and Development research is an applied research method that is used to create a link between practice, research, and theory in addition to providing a solution to practical problems(Richey, Klein, & Nelson, 2004). The importance of Design and Development to the IDT field lies in its attempts "to produce the models and principles that guide the design, development, and evaluation processes" (p. 1102). The two major types of design and development research are a) product and tool research and b) model research. These two categories of design and development research have been previously called Type 1 and Type 2 (Richey et al., 2004) but it may be easier to grasp the nature and breadth of these types by looking at their general outcomes. The first type of research pertains primarily to studies of the design and development of products and tools, such as the Fox and Klein (2003) study that was conducted to provide a better understanding of what instructional designers and technologists should know about HPT. The second type of design and development study is oriented toward studies of development, validation, and use of design and development models. For example, Plass and Salisbury (2002), faced with the problem of designing a knowledge management (KM) system that needed to accommodate continuously changing requirements over its fielded lifetime, developed a new design model that is based on a living-systems approach.

The current research study can be classified as Type 2 in that it addressed the design and development of a framework that can be implemented and generalized with a generic focus to enhance the existing ID models.

As explained by Richey and Klein (2007), this type of research is pragmatic and it offers a way to test theory and validate practice that has been perpetuated essentially through unchallenged tradition. In addition, it is a way "to establish new procedures, techniques, and tools, based upon a methodological analysis of specific cases" (p. 1).

This model research study had two phases and emphasized a framework's development and verification. The outcome is a new design and development framework where the conclusions are generalized.

Strategies for Model Development Research

The proposed new framework could be developed by using any of the following two ways. As explained by Richey and Klein (2007), most new ID models are constructed "by applying a diverse body of research and thinking of the times to the task of creating instructional products; therefore, the process of creating a model is a logical process of synthesis" (p. 66). The well-respected Dick and Carey' model (1996) was initially formed in this fashion.

Other model construction procedures have been suggested. Reigeluth and Frick (1999) proposed to use formative research methodologies, a type of development research. This approach involves creating a case to help generate the model, and then entering a repeated process of collecting and analyzing formative data on the case and revising it as warranted. There is also research that specifically describes model construction. Jones and Richey' (2000) study, for example, resulted in a revised rapid prototyping ID model. This model was based upon interview data describing designer tasks performed while using rapid prototyping techniques, the concurrent processing of those tasks and the nature of customer involvement.

Another way to develop a new model is to collect data directly from designers and developers while they are designing an instructional unit that would involve the repurposing of existing media. A representative example of this method to develop a new model is a mixed-method study (Spector, Muraida, & Marlino, 1992), where data were collected during a simulated design and development task, and a cognitively oriented model for designing computer-based instruction was developed.

In this study, the research techniques employed for developing a new framework were the conduct of a literature review and synthesis of the findings into a design framework. As the next step, the researcher developed a short instructional module according to this framework, and the data were collected on the tasks performed by the researcher to accomplish this simulated product.

Phase One Goals

According to the research design, the goals of the Phase One of the study were:

(1) Examine the first section of the literature review and identify theoretical foundations from Instructional Systems Design that provide assistance in developing a framework for media content selection.

(2) Examine the second section of the literature review on the repurposing of popular media and identify how the findings could inform the development of the framework.

(3) Examine the third section of the literature review on learning theories and the ways they influence the instructional design theories and practices. Use the findings to create the framework. In addition, a literature review section on a new generation of learners (digitally natives) was examined to explore what new learners' characteristics should be addressed by the framework.

(4) Examine the last section of the literature review on integration (interdisciplinary links) and use the findings to incorporate integration into the framework.

(5) Decide on the components of the framework that address repurposing of popular media.

(6) Develop a coherent instructional framework that provides a pragmatic method of

developing instruction in the field of mathematics and science that incorporate the repurposing of popular media.

(7) Use the newly –constructed framework to develop a piece of instruction in the field of mathematics and science that incorporate the repurposing of popular media.

Findings from the Literature Review

Instructional models. The examination of the literature on instructional models allowed the author to obtain a good glance at the "landscape" of instructional design models and clearly realize that there are various types of instructional models, each serving its own purpose. For example, there are models that describe a pedagogical strategy in detail, such as Nine Events of Instruction by Gagne, or Inquiry-Based Learning. Another type of models provides a method to create a design such as ADDIE. Other models address some specific things such as evaluation or learner needs.

The realization of the sheer amount of existing instructional models somewhat intimidated the author and encouraged her to provide a strong rationale for developing her own framework. Below are the findings based on this section of the literature review and their implications for the author's research on creating a framework for media content selection.

Rationale for using instructional models. Martin Ryder' webpage (Instructional Design Models, 2013), perhaps, provides the most poetic description of the instructional models and their role in the IDT field by "rhapsodizing" about them as follows: "Models, like myths and metaphors, help us to make sense of our world. Whether derived from whim or from serious research, a model offers its user a means of comprehending an otherwise incomprehensible problem. An instructional design model gives structure and meaning to an I.D. problem, enabling the would-be designer to negotiate her design task with a semblance of conscious understanding. Models help us to visualize the problem, to break it down into discrete, manageable units."

Instructional models serve as the road maps for designers and direct them in providing procedural framework for the systematic production of instruction. Models incorporate analyses of the intended audience, determination of the goals and objectives, and other fundamental elements of the instructional design process. They simplify the complexities of real situation into sets of generis steps that can be applied in many contexts (Gustafson & Branch, 2002a).

Gustafson and Branch (2002a) developed taxonomy of models based on specific characteristics. The taxonomy describes models as being classroom-oriented, product-oriented, or systems-oriented. Classroom-oriented models usually have an output of one or a few hours of instruction; product-oriented models have an output of an instructional package; and, systems-oriented models have an output of a course or curriculum.

Many instructional design models, when diagrammed, appear to be linear and rigid. In practice most are iterative, moving backwards and forwards between the activities (Moore, Bates, & Grundling, 2002) . Most are also flexible; leaving it to the experienced designer to decide how much detail is required at each step. This flexibility and iterativeness may explain why ISD has survived and flourished for so long largely unchanged (The Herritage Group, 2004).

For example, the Morrison, Ross and Kemp model (2004) is a classroom-oriented and describes a holistic approach to instructional design that considers all factors in the environment. It is extremely flexible and prescribes a process that is iterative and subject to constant revision. One of the elements of this model that differentiates it from other models is that this model takes a general systems view towards development (model components are independent of each other) with instructional design being presented as a continuous cycle (The Herritage Group, 2004). Using this model the instructional designer begins by asking six questions: required level of learner readiness; the instructional strategies and media that are be most appropriate for the content and the target population; the level of learner support required; the measurement of achievement; and the strategies for formative and summative evaluation (Morrison, Ross, &Kemp, 2004).

The implication of this finding is that it encouraged the author in her pursuit of creating a new framework for repurposing popular media with the hope that this framework can be incorporated into existing instructional models. The goal was to develop a framework that other designers can follow in order to create an instructional program at various levels of granularity. More specifically, this framework should include the following features and capabilities:

a) Even though the author's preference was the repurposing of popular media in relation to mathematics and science instruction, this framework, in general, needed to describe the process for developing any instruction regardless of the field of study.

b) This framework should incorporate the major elements of the instructional design process including analysis of indented learners, determination of instructional goals and objectives, and identification of learning activities.

c) Based on taxonomy of models provided by Gustafson and Branch (2002a), this framework is a classroom-oriented model that will require a low-level of instructional design skills, so that even novice designers and practitioners are comfortable using it to create intended instruction.

d) Following in the steps of Morrison, Ross and Kemp, the framework should be flexible enough, so that its elements are independent of each other and they do not need to be considered in any particular order.

Core elements of instructional models. In spite of a great amount of instructional models and the complexity of some of them, there are some common features or core elements that most of the models possess.

In the literature review section on instructional models, the author of this study cited Gustafson (2002b) , who stated that most instructional development models include core five elements in their foundation(Analyze, Design, Develop, Implement, and Evaluate), and are variations of the ADDIE process.

Moore et al. (2002) identified basic elements reflected in most models. These basic elements include the following actions:

• Determining the needs of the learners and examining the learning context and environment

• Determining the outcomes of the learning program or course and formulating the learning objectives

• Developing appropriate and meaningful assessment criteria and procedures

• Establishing the most effective approach(s) to delivering the instruction

• Testing and evaluating the effectiveness of the instructional system (both the instruction itself and the performance of the learner)

• Implementing, adjusting and maintaining the instructional system

Alessi & Trollip (2001, p. 7) outlined a “bare-bone” instructional model and called it “the process of instruction”. It has four activities or phases of instruction that should occur for learning to be effective and efficient:

- Presentation of information (this stage is instructor or media centered)
- Guide the leaner (this stage is more interactive and includes both the learner and the medium)
- Practice (this stage enhance fluency and retention through drills, simulations, construction tools, etc.)
- Assessing learning

This finding assured the author that her goal of incorporating the newly developed framework into existing instructional models is achievable and the process of incorporation can be generalized since most of the models have common core elements.

Main characteristics of media selection models. Based on the section of the literature review related to media selection models, the author has concluded that media selection models developed to date cannot be regarded as easy- to- use and satisfactory instruments. The common practice is to base selection on factors such as task, cost, learners' characteristics, settings, and others. Some authors (Koumi, 1994) suggest that the most common practice in selecting media is not to use a model at all.

According to Morrison, Ross, and Kemp (2004), there are three different approaches to media selection: (a) selection based on what is readily available; (b) selection on the basis of what a trainer is most familiar with or most comfortable using (this assumes that a human trainer is the principal medium); and (c) selection on a more objective basis whereby some guidelines can be followed so that selection can be justified in a non-subjective manner.

In many media selection models, learner characteristics, settings, and task are considered important to the selection decision. However, the extent to which the models stress consideration of these factors varies greatly. Some models are very particular in asking questions such as: In what location (e.g., school, home) is the instruction to be delivered? Is the instruction to be presented to individuals or to a group? What is the size of the group?

Another set of models consider the learner characteristics as a defining factor to the selection decision. Many educators believe that media may be differentially effective for different types of learners, and therefore media that are best suited for various learner types should be identified (Sugrue & Clark, 2000).

Finally, the categories of learning outcomes are an integral step in many media selection models. Most of the models included some or all of the categories of learning identifying by Gagne (1977): intellectual skills, verbal information, motor skills, attitudes, and cognitive strategies.

The main finding for the author was the realization that reviewed media selection models mostly address the selection of media-as-technology and help to decide between cross categories such as print, broadcast media or multimedia options, and media attributes such as audio, motion, or two-way communication and interactivity.

A medium does not have any influence on cognition; neither do its attributes (Clark, 1983). A medium's attributes merely permit the delivery of some method that has cognitive consequences. Each new wave of media spawns a group of proponents who attempt to attach cognitive consequences to the newer media or newer media attributes rather than to methods which are the real source of the hypothesized cognitive effects (Sugrue & Clark, 2000). As Sugrue and Clark argue, "the interactive video portions of some programs, for example, the Jasper Woodbury mathematics series could be delivered in other media. The critical media attribute in this case is the ability to present scenarios or problems in a realistic situation" (p. 9).

In the author's view, which is in sync with the views of Sugrue and Clark (2000), the most fruitful and valid approach to media selection is the ability to support so-called instructional events, which in turn support essential cognitive activities. While many authors have recommended matching media to events of instruction, few have elaborated on how that might be done (Sugrue & Clark, 2000).

The main implication of this finding is that the newly proposed framework will be centered in the selection process of the media content- appropriate pieces and chunks of the chosen multimedia (TV shows, movies, or video games). The main factors that will influence the decision for the selection of the media content will be the following:

- Learners' characteristics (age, type of learner)
- Learning objectives and outcomes
- The ability of selected media to support a specific instructional method
- Matching media to instructional events
- The ability of selected media to provide integration within a discipline and with other disciplines

Why we need more models? The author has already mentioned that she was overwhelmed by the number of the existing instructional models. There are several explanations that justify a great number of instructional models. One of them is that the amount of models reflects the complexity and richness of the IDT field. Yet, Clark and Estes (1998) questioned the sheer number of models as well as their generalizable usefulness and scientific grounding.

Elen and Clarebount (2010) also warned that one should not be blind to the origins of this diversity, the first origin being the dual nature of instructional design. From one side, instructional design has been portrayed as a field of scientific enquiry. While the number of scholarly publications provides evidence for this statement, it must also be pointed out that instructional design is an economically important activity. Most instructional designers are not researchers who attempt to generate answers to the IDT research question, but professionals who attempt to apply instructional models to a variety of highly complex and diverse settings. Designing instruction, especially with novel technologies; training, and consulting about designing instruction is a profitable and competitive business. In the instructional design market it is a trump to have one's own model, to be a name in the field and be recognized as an authority (Elen & Clarebout, 2010).

The second reason listed by Elen and Clarebount (2010) for the large number of instructional models might even be more dramatic. Clark and Estes (1998) believe that the field of instructional design is more like a craft than a technology. Whereas a technology looks for the active ingredient and hence develops solutions that are widely applicable, a craft is experience - based. Solutions proposed by a craft provide solutions that have indeterminate causes. And, although broad applicability is claimed, these solutions can be transferred only with great difficulty to other settings. In the absence of an in - depth explanation it is impossible to determine for what problems and in what situations the solution is a suitable one.

At the same time, it is inevitable that the new instructional models will keep appearing. For example, in terms of media selection models, some of the old models were appropriate for the media configurations commonly available ten or twenty years ago, but are less appropriate for the kind of sophisticated delivery systems now available.

Implications of this finding are the following. Within this section of findings from the literature review on instructional models, the author underlined the reasons for the great amount of instructional models including media selection models. It is important to highlight here the reason why there is still a need for a new framework/model:

1. The goal of the author is not to have her own model, to be a name in the field and be recognized as an authority. Her goal is to make a small but valuable contribution to the IDT field.

2. The author recognized the dearth of information on how media are actually selected for learning and teaching in the real world.

3. The author acknowledged the presence of blurred distinctions between media, its attributes and instructional strategies in many existing media selection models.

4. Finally, based on the literature review, it was found that there is no media selection model that is able to guide an instructional designer in selection of media in terms of the subject/discipline content.

Summary of findings on instructional models. The goal of this study is to develop a framework for repurposing popular media that other designers can follow in order to create an instructional program at various levels of granularity. The rationale for the need of this framework is based on two findings: 1) existing media selection models seem inadequate for making decisions about selection of media in terms of it subject content, 2) a developed framework can be incorporated into most existing models since all of them have the same core elements.

This framework/model 1) will be a classroom-oriented model that will require a low- level of instructional skills, 2) will describe the process for developing any instruction using media regardless of the field of study, 3) its elements will be independent of each other and there will be no need to consider them in any particular order, 4) the main factors that influence the media content selection will be learners' characteristics, national learning standards, the ability to support a particular instructional event, and possibility of integration within and between disciplines.

Repurposing popular media. This section will focus on findings that have emerged after investigation of relevant literature on the repurposing of popular media. These findings summarize research that has been conducted regarding the repurposing of popular media, including film, television, and video games for instructional use; trends that have appeared over the course of this research; and the impact of this research on educational practice.

Importance of combining popular media with education. In many ways, popular media and culture - the Facebook photo, a scene from a popular TV show or a Hollywood film, a post from the Twitter, and others - document and reflect our lives. The power of popular media is both diffuse and indisputable. The realization that their students interact with a vast amount of popular media—TV shows, books, video games, advertisements, film, etc.—requires educators to become aware of and fluent with the diverse popular media materials their students interact daily and utilize popular media for educational purposes (Roberts et al., 2003).

The current research on influence and impact of popular media on mathematics and science education revealed that popular media such as movies and TV shows can liven up the classroom and bring energy and motivation to the course, while also illustrating the course concepts and enabling students to see science theories and laws in action. Therefore, the usage of popular media in a classroom can influence science education: depictions of science in popular films and TV shows can improve content knowledge and stimulate interest for advanced study of science.

This finding resulted in the following implications. The author of this study advocates the educational application of popular media and the new framework will guide instructors in selecting popular media. Popular media such as feature films, TV shows, and video games can be successfully used in education to:

- Illustrate course concepts
- Increase students' understanding of material
- Provide a common experience for all students
- Allow students to connect personally to course content
- Increase students' motivation and excitement

Bloom's taxonomy (1956) illustrates various levels of learning. His taxonomy is visual hierarchy with knowledge at the bottom, comprehension, application, analysis, and synthesis in the middle in ascending order and finally evaluation at the top. Bloom was concerned that too much emphasis is put on the lower levels of learning and not enough at the top. His concern is even more current today since exponential growth of knowledge requires today's learners to apply such functions of learning as analysis, synthesis and evaluation. Used effectively, popular media can take students to the higher levels of application, analysis, synthesis, and evaluation as they apply theories and laws to actions on the screen, create new scenarios or endings to selected scenes, and evaluate the quality of media's presentation of relevant principles and concepts.

The modern generation of students come to their classrooms with a long history of playing video games as well as watching TV shows and movies, and we are suggesting that educators take advantage of this natural enthusiasm, transferring its energy to school subjects, especially to such challenging to many students academic disciplines as mathematics and science. Then, difficult concepts from the textbook will become embodied in a compelling media and students will discuss with enthusiasm and increasing confidence the ways in which popular media exemplify mathematical or science principles, concepts or laws.

What it means to repurpose popular media. As was established in the literature review, the term repurposing refers to the changing of popular media (such as film, book, TV show, video game, etc.) that was *not* initially created for a specific educational use, to a new educational context. Therefore, repurposing refers to modifying the content or the learning design. Repurposing can further be divided into (a) repurposing for reasons of localization – e.g. translation to a different language, or minor changes to account for cultural differences, and (b) repurposing to incorporate substantively new content – e.g. taking an activity used in a history course, and adapting it for use in a science course. Another dimension of repurposing lies in changing the learning design, rather than changing the resource itself. So, a learning object that is reused without any change to its original content or function, yet is used in a different way to that originally envisaged by its creator, has in a sense been repurposed.

Educational content repurposing is a popular activity in which many educators are routinely engaged when preparing a new learning experience for their students, including preparing the educational content itself.

Implications of this finding are the following. Repurposing popular media, including film, television, and games is a trend that is gaining popularity amongst educators. Media repurposing decreases the cost, since repurposing avoids all the money associated with starting from scratch, and yet can provide new and exciting ways to engage and motivate students. However, media repurposing is not an easy task and sometimes it involves changing the content or modification of the original pedagogical intent, or in some cases the development of new pedagogical approaches.

The necessary part of the repurposing process is that teachers take a film, or a TV program, or a video game and make it their own. The purpose of a new framework is not to help practitioners to change the media resource itself, it would rather provide guidance and support for designers and educators in choosing appropriate media content and repurpose it for new learning designs and pedagogical approaches.

How educators go around selecting popular media. Most educators agree that inclusion of popular media into curriculum may present a more holistic and realistic view of relevant course concepts than textbooks but empirical research on this topic is sparse. However, there is ample anecdotal evidence of the effectiveness of using popular media to teach course concepts in various disciplines. Many researchers reported a higher quality of student work and investment in media-based assignments, deeper content knowledge, and more insightful reflections on the learned materials.

Opponents of the usage of popular media argue that showing film or TV clips means the instructor is not really teaching. The argument is that instead of lecturing or engaging in discussion, the instructor is simply turning to a film or TV show and letting popular media deliver the material.

Another potential limitation of using popular media to teach specific discipline concepts is the amount of time necessary to prepare and select media. From the reviewed research, it is unclear how educators select media, what criteria they use to decide what segments or scenes to utilize, and, most importantly, how the selected media is aligned with the learning goals, outcomes, and the national standards (for K-12 settings).

This finding resulted in the following implications. It is the author's contention that designers and practitioners must be aware of the potential abuse of class time and should structure learning activities that promote an active, not passive use of popular media. The proposed framework seeks to remedy potential limitations and pitfalls of the repurposing of popular media and provide support in structuring the media activity educationally. A new framework will assist designers and educators by providing guidance in repurposing popular media as they work through and shape it into a new instantiation.

Inclusion of popular media for teaching STEM disciplines. The literature review on repurposing popular media such as film, TV shows and video games has resulted in two important observations: a) the bulk of papers described the repurposing of popular media in the context of the college-level courses. Considerably fewer studies reported repurposing in K-12 settings, b) a sprinkling of repurposing applications of popular media in school subjects such as mathematics and science became very obvious.

These results can, at least partially, be explained by the lack of educators' training in repurposing popular media as well as by the absence of clear guidelines how to design, create and implement new learning experience that involve popular media.

Implications are the following. Even though, the author claimed earlier that the proposed framework will describe the process for developing any instruction involving repurposing of popular media regardless of the field of study, the focus of a new framework will still be on the disciplines related to STEM subjects, specifically, mathematics and science, taught in K-12 settings.

Summary of findings on the repurposing of popular media. Educational application of popular media has a great potential and can be used to illustrate main principles and concepts of a particular discipline, improve students' understanding of the subject's content, and to increase engagement, motivation, and enthusiasm towards learning. Used effectively, popular media can take students to the higher levels of learning by applying theories and laws to what they see or experience on the screens, as well as analyze and evaluate the quality of media's presentation of relevant principles and concepts. Another benefit of media repurposing is that this approach saves money and decrease the cost of the production of new instructional materials.

The purpose of the framework is to provide a step-by-step guidance for designers and educators in choosing appropriate media content and repurposing it for new learning designs and pedagogical approaches.

The new framework must identify what criteria designers and practitioners should use to decide what segments or scenes to utilize and prescribe steps to follow to insure that the selected media is aligned with the learning goals and outcomes.

Finally, the new framework focuses on development of new learning environments that incorporate repurposing popular media for mathematics and science instruction.

Learning theories. Examination of research on learning theories and their influence on the instructional design practice has led to the following findings.

The link between learning theories and instructional design. The author has gained a clear picture on how instructional design theories are drawn from learning theories. Instructional design theories, in turn, guide designers in developing best design instruction so that productive learning can occur. More focused understanding has been obtained on how every new learning theory influences and adds to the practice of instructional design.

A solid foundation in learning theory is an essential element in instructional design practice because it permeates all steps of instruction development. Depending on the learners and situation, different learning theories may apply. The instructional designer must understand the strengths and weaknesses of each learning theory to optimize their use in appropriate instructional design strategy.

For example, Ertmer and Newby (1993) posit that the instructional approach used for novice learners may not be efficiently stimulating for a learner who is familiar with the content. They do not advocate one single learning theory, but stress that instructional strategy and content addressed depend on the level of the learners.

Implications of this finding are the following. The current trend is utilization of a synthesis of elements of the various advancements in cognitive science and educational technology. After having compared and contrasted behaviorism, cognitivism and constructivism, the author of this study feels that a new framework/model should be in sync with this trend and instead of providing a single recipe for the best approach for all learning situations it should guide the designers to find the most effective approach to achieve specific performance outcomes. A distinction should be also made between novice learners where more behaviorist and cognitivist approaches should be applied and advanced learners where constructivist strategies are more appropriate. With this approach the designer is able to draw from a large number of strategies to meet a variety of learning situations.

Behaviorism/Cognitivism and instructional design. When cognitivism became the leading learning theory, the design models that had been developed in the behaviorist tradition were not simply tossed out, but instead the "task analysis" and "learner analysis" parts of the models were embellished. The new models addressed component processes of learning such as knowledge coding and representation, information storage and retrieval as well as the incorporation and integration of new knowledge with previous information (Saettler, 1990). Because cognitivism and behaviorism are both governed by an objective view of the nature of knowledge, the transition from behavioral instructional design principles to those of a cognitive style was not drastic. The goal of instruction remained the communication or transfer of knowledge to learners in the most efficient, effective manner possible (Bednar et al., 1992).

The implications of this finding are the following. The author values Behaviorism and Cognitivism contribution to the field of ID and intended to embed these theories assumptions into her model. Behaviorism introduced response - consequence associations such as practice and reinforcement into designing practice. Behaviorist principles are still used in drill and practice on- line tutorials with positive or negative consequences such as social comments before moving to the next learning objective. Cognitivism emphasizes schematic organization, analogical reasoning and algorithmic problem solving.

The cognitive theory is the dominant theory in instructional design but many of the instructional strategies advocated and utilized by behaviorists are also used by cognitivists, but for different reasons. For example, behaviorists assess learners to determine a starting point for instruction, while cognitivists look at the learner to determine their predisposition to learning (Ertmer & Newby, 1993). With this in mind, the author anticipates that a new framework will be developed with mostly the behaviorist/cognitivist approaches.

Constructivism and instructional design. It is more challenging to design from a constructivist approach which requires that the designer produces a product that is much more facilitative in nature than prescriptive. The content is not pre- specified, direction is determined by the learner and assessment is much more subjective because it does not depend on specific quantitative criteria, but rather the process and self-evaluation of the learner (Mergel, 1998).

Implications of this finding are the following. Constructivism introduced such important strategies as presentation of multiple and alternative views to learners and rich learning environments. A new framework will incorporate some of the assumptions of constructivism, specifically the ones that suggest that learning is an active process in which meaning is developed on the basis of experience and learning should be situated in realistic settings. However, the author believes that constructivist approaches are most beneficial when placed within the context of larger learning environments. For example, guiding learners can include discovery techniques.

A new generation of learners. There is an ongoing discussion with some researchers claiming that new approaches to learning are needed to accommodate the new generation of learners that possess new characteristics such as a novel capacity to multitasking, requirements for prompt feedback and rapid access, just to name a few. Other researchers challenge this view by arguing that the new learners' natural aptitude and high skills when using modern technologies do not "translate" adequately when used for academic activities. Moreover, some researchers list unfavorable characteristics of this generation who lack critical thinking skills and the ability to focus on one task for continuation of time.

Implications of this finding are the following. Even though the author of this study disagrees with the argument that a new generation of learners is so different that they need completely different approaches to learning, she acknowledges that, in many cases, the traditional methods are not bringing about the desired results. Therefore, a new framework should provide guidance in developing a comprehensive, effective, accessible and practical approach that is grounded in increased learner activity, engagement, and use of technology.

Summary of findings on learning theories/ new generation of learners. Even though, the author of this study acknowledges the modern trend of eclectic approach to instructional design, she personally is not in a full favor of a “mix and match” approach strategy to instructional design. She supports the view of Bednar et al. (1992) that effective instructional design emerges from the deliberate application of a particular learning theory. Her personal beliefs about the nature of learning are consistent with the assumptions of objectivist approaches; therefore, a new framework will be based on concepts and strategies of Behaviorism/Cognitivism learning theories with inclusion of some of the assumptions of constructivism.

Integration. To integrate means to coordinate, blend, or bring together separate parts into a functioning, unified, and harmonious whole. As explained by McNeil (1985), curricular integration assists students to identify the links, not only between ideas and processes within a single field, but also between ideas and processes, in separate fields, and in the world outside of school.

Based on examination of a body of appropriate literature on integration/interdisciplinary links, the following findings have emerged.

Existence of many different and conflicting terms for integration. A large number of terms are used to describe integration, and there is a noticeable absence of formal, unanimously-accepted definition. There are also a great amount of approaches to integration ranging from integration within single discipline to scheduling related topics in different disciplines, and to integration within and across learners. The discussion about integration is an ongoing process and more clarification on the topic is still needed.

Implications of this finding are the following. It became clear that inclusion of integration into a new framework will be a challenging endeavor. The author has determined that integration within a new model should meet several criteria. First, the framework should guide the designers in such a way that integration is used in purposeful tasks that promote rich learning environments. Second, the integrity of the subjects should be respected and the central purposes of each subject are not compromised by integration. Third, a new framework should provide guidance as to how utilize the commonalities of process and content shared by the integrated disciplines.

Support for integration and paucity of research. It was found that support for integration of subjects is wide and include researchers, government and subject associations. They believe that there is value in and a need for interdisciplinary instructional approaches. Teachers and administrators identified student engagement as the most positive aspect of integration. Administrators noted that strong engagement levels alleviated behavior problems, and teachers described students as being excited and stimulated to work beyond expectations since connections to the real world motivated students, and their interests, in turn, shaped instruction. Teachers, impressed by the level of classroom discussion, concluded that integrated curriculum lends itself to higher order thinking skills (Drake & Reid, 2010).

For the author of this study, the main reason for the need of integrated practice is relevance of curriculum. In real life, students deal with physical phenomena, problems, concepts, and concerns in a flow of real time that is not divided into school subjects. Every day we deal with the whole of our lives not divided into physical or chemical laws, mathematical formulas, or economic theories. It does not mean that we need to stop teaching specific subjects; rather we need to create learning environments where connections between various disciplines are highlighted and their mutual relevancy is demonstrated.

Another important finding is the paucity of empirical evidence for benefits of curriculum integration. Among the research-supported claims are increased motivation and engagement of learners.

These findings resulted in the following implications. In spite of the limited empirical evidence to support integration, the author of this study has decided to include integration as an integral part of her framework for two important reasons. First, among the studies that have been done to show a positive impact of integration, many are related to integration of mathematics and science – the two subjects the author is most interested in. Some of these studies have shown that integrating mathematics and science has a positive impact on student attitudes, motivation to learn mathematics and science, and academic achievement.

Second, in her personal teaching experience, the author often used integration within one discipline (mostly mathematics) and between disciplines (mathematics and physics, mathematics and chemistry, chemistry and history of human civilization, and so on) and observed some of the benefits of integration claimed by the research.

Pitfalls of integration. Literature examination revealed two major problems with integration practice that even dedicated teachers with good intentions and goals towards integration often experience. One problem, called "the Potpourri problem" by Jacobs (1989), relates to approaches when teachers substitute integration by sampling of knowledge from various disciplines without clear focus. Another problem was called "the Polarity problem" by the same author. With this approach, teachers feel highly territorial about their subject and are not open to welcome the new views of their disciplines.

Other researchers identified this second problem as the pseudo-interdisciplinary approach (Lenoir et al, 2000) and claim that it is most often used by the teachers, especially in early grades. It is recommended that integration and inter-disciplinarity, instead of leaning towards of the extremes (polarity – potpourri), should be situated somewhere at the crossroads between these polarities.

Implications of this finding are the following. The author has realized that it will be a very challenging and daunting task to provide guidance for integration that utilizes many approaches; therefore, a new framework will be mostly focused on integration within one discipline or integration between mathematics and science. It is this focus on making connections (one topic to another one, or one concept to another, or one skill to another) that underlines this form of integration. Science and mathematics can be integrated to make disciplines relevant and meaningful to the learner. Mathematics, when integrated with science, provides the opportunity for students to apply these two disciplines to real-world situations that are relevant to their everyday lives.

The role of teachers' content knowledge on integration. Another major finding of the literature review was the realization that a source of difficulty in gauging integration is a questionable teacher content knowledge and understanding of what integration means. If integration is a desired practice then teachers must have a strong sense of what it means to integrate. It is suggested that an extensive amount of professional development is needed for teachers. This professional development must include extensive practice in the use of integration-oriented pedagogy.

Implications of this finding are the following. The new framework should be flexible and designers should have a choice to decide whether integration is a desired practice. To accommodate this, a new framework should provide a checklist/self-assessment for users to help them decide if inclusion of integration will benefit the instruction.

Summary of findings on integration/interdisciplinary links. Based on the examination of literature, the author has determined that integration should be an integral part of the framework. The framework should guide the designers to develop instructions that provide opportunities for students to use learning from mathematics and science (or any other two subjects) to support learning in such a way that learning in both subjects is enhanced. The framework should also direct designers to the most beneficial approach to integration in every particular case:

a) Within one subject (integration between two mathematics topics)

b) Between two subjects (mathematics and physics)

Another important feature of the framework is that the designers have the choice to decide whether they need to use integration. Since the framework is going to be flexible, they can attend to its components they need to address, and disregard those that they do not.

Summary of findings and implications from the literature review. The goal of this study was to develop a framework for content selection and the repurposing of popular media such as TV shows, film, and video games to enhance mathematics and science instruction.

Rationale for the need of this framework was based on several findings:

1) Existing media selection models seem inadequate for making decisions about selection of media in terms of it subject content.

2) A developed framework can be incorporated into most existing models since all of them have the same core elements.

3) When selected and used effectively, popular media (in terms of the content) can take students to the higher levels of learning such as analysis, synthesis, and evaluation.

4) Instructional design models do not often appear to take a multidisciplinary approach; thus, often omitting the most effective and innovative options for new creative learning environments.

The proposed framework has the following features and characteristics:

1) Is a classroom-oriented model that will require a low- level of instructional skills

2) Is based on concepts and strategies of behaviorism/cognitivism learning theories

3) Incorporates some of the constructivist approaches placed in the context of larger learning environments (factors for inclusion are learners' characteristics – novice learners versus advanced learners - and events of instruction)

4) Is centered on mathematics and science instruction

5) However, describes a general process for developing any instruction using media regardless of the field of study

6) The framework elements are independent of each other and there will be no need to consider them in any particular order

7) The main factors that influence the media content selection are:

- learners' characteristics
- learning objective sand outcomes
- the ability to support a particular instructional event
- possibility of integration within and between disciplines

8) Integration will be an integral part of the framework. Integration:

- will be within one subject (integration between two mathematics topics)
- or between two subjects (mathematics and physics or biology)
- will support learning in such a way that learning in both subjects is enhanced
- the flexibility of the framework will allow designers to decide whether they need to use integration or not

Chapter 4: Phase One - Framework Development

Introduction

"Design and development research covers a wide spectrum of activities and interests, in its simplest form it can be the study of the design and development process as a whole, or of particular process components," (Richey & Klein, 2007, p. 7). As these authors describe further, model development research results in the development of new or enhanced models to guide the ID process. This research may emphasize comprehensive models or particular design techniques, or process (p. 11).

Over the years, many various lines of inquiry emerged within model research with two main clusters being: comprehensive model development and development of model components to enhance existing models.

The techniques for the Framework Development in this study incorporated suggestions from a checklist for addressing common concerns of model research design by Richey and Klein (2007) (Appendix A). These techniques include:

- to use design tasks that are realistic in scope;
- account for the effects of design and development time
- account for resources

For Generalization and Interpretation, the techniques used for Framework development were:

- Collect data from natural work setting
- Account for different settings

During the instructional design process, several important decisions must be made. First decisions must be made regarding which medium is the best fit for delivering the instruction. Many existing media selection models provide assistance in this process. Second, decisions must be made regarding the appropriate content within the selected media. The choice of the appropriate media content should result from detailed analyses of the target learners, learning objectives, instructional strategies, and so forth. Selection of content—including topics, objectives and strategies—might be intuitive to some designers and educators, but others might benefit from a systematic tool for matching content to their learning approaches and audience, a tool that will simplify the complex media content selection process. The proposed framework can serve as this tool. Although the Framework draws more from theory than from a practitioner's experience, the Framework uses the language that is familiar and applicable to most practitioners.

Description of the Framework

The Framework for media content selection was developed with the intent of guiding designers and educators through the complicated process of choosing the most appropriate media content for instruction. As technology evolves and new technologies and multimedia formats become available, users of the Framework can continue to use this tool for media content selection since the process does not rely on the attributes of media; therefore, they will be able to evaluate the currently available technologies and adjust the recommendations of the Framework.

The first iteration of the Framework (see Figure 7 on page 90) includes four core elements that, as was discussed, most instructional design models possess – Analysis, Design, Development, and Evaluation. The general structure of the Framework follows this logic:

the Framework consists of three ellipses. The innermost ellipse represents the four core elements of instructional design models and dictates the familiar flow of the designer work in a clockwise sequence. The middle ellipse dictates what should be considered and taken under consideration in order to select media content to support instruction. Finally, the outmost ellipse shows the results – what should be an outcome of each stage of a designer work. In addition to the Framework graph, the designers will navigate the Framework using 3 matrices that will be discussed later.

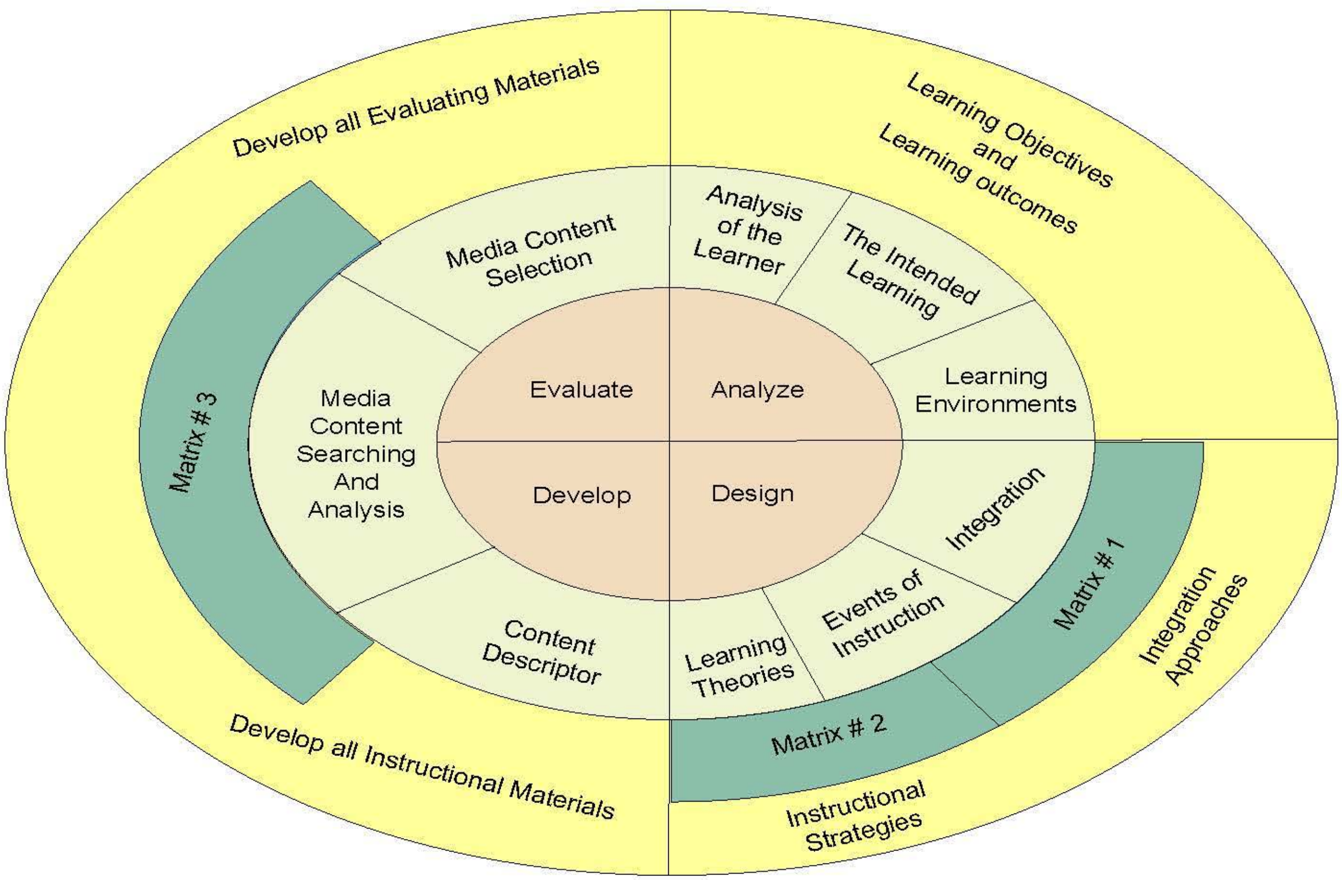

Figure 7: The Framework for media content selection.

Although the components are described in a logical clockwise sequence, the order a user can address the elements is not predetermined. A designer can skip some of the elements or take different paths. If followed in a logical sequence, the components of the Framework are the follows:

Analysis: The analysis step involves the analysis of the learner, the intended learning or the content to be learned, and the learning environment. Knowing learner capabilities aids a designer in the design phase of instruction. Since people, especially small children move continuously through stages of physical and mental ability, and emotional and social development (Dewey, 1938; Erikson, 1950; Montessori, 1965; Piaget, 1952a, 1952b; Vygotsky, 1978), the Framework must give more weight to the characteristics of learner in terms of their age and developmental stages. The Framework is fluid in that that learner characteristics and capabilities may be incorporated in instructional strategies and in the evaluation stage of the instruction. Upon completion of the analysis stage, the learner characteristics and the content to be learned are used to assist in writing the learning objectives. These objectives must then be categorized into one of the five domains of learning outcomes. Based on Gagne's classification of learning outcomes, in this Framework we considered verbal, intellectual, cognitive, psychomotor, and attitudinal learning outcomes. Each of the objectives must be stated in performance terms using one of the standard verbs (i.e. state, discriminate, classify, etc.). The determination of learning outcomes is important in selecting the most appropriate media content. Figure 8 on page 92 represents the suggested navigation through the Analysis phase of the Framework. Upon completion of this task, the designer moves to the Design stage.

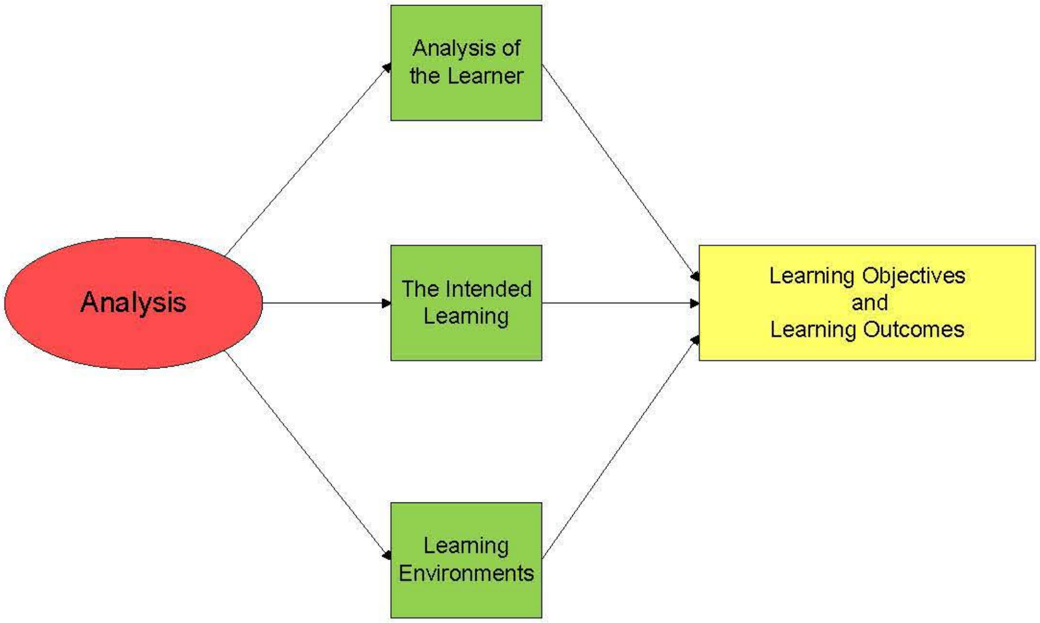

Figure 8: Suggested navigation through the Analysis phase of the Framework.

Design: During the design stage, three important steps should be taken. First, the decision about integration/interdisciplinary links should be made. At this point, the Framework sends designers to Matrix # 1 where they need to answer integration-related questions regarding their unique case (see Table 1 - Matrix # 1on page 97), and decide whether integration should be a part of instruction, and if so, what approach to integration they are going to use.

Next, a designer should decide for what event(s) of instruction the media content should be selected. Each of Robert Gagne's nine instructional events (Gagne & Briggs, 1974) – gaining attention, describing the goal, stimulating recall of prior knowledge, presenting the materials to be learned, providing guidance, eliciting performance, providing feedback, assessing performance, and enhancing retention and transfer - requires a particular approach to selection of media content.

At this point, the Framework directs users to Matrix # 2 (see page 99). After the user decides on the desired learning outcomes and the event(s) of instruction that the media content should be selected for, s/he needs to consider the learning theory that guides the development of instruction. Matrix # 2 lists four major learning theories: OLT - objectivist learning theories (behaviorism and cognitivism), CLT- constructivist learning theories, TSCD – Vygotsky's theory of social cognitive development (Vygotsky, 1978), and MIT-multiple intelligence theory (Gardner, 1983). In the last column, the matrix provides some examples of instructional strategies that correspond to each learning theory. As the user moves forward in the Framework, s/he identifies instructional strategies.

Instructional strategies are the various procedures used to involve the learners in the learning process, such as questioning during lectures, reflection after reading, etc. Figure 9 represents a suggested navigation for the Design phase.

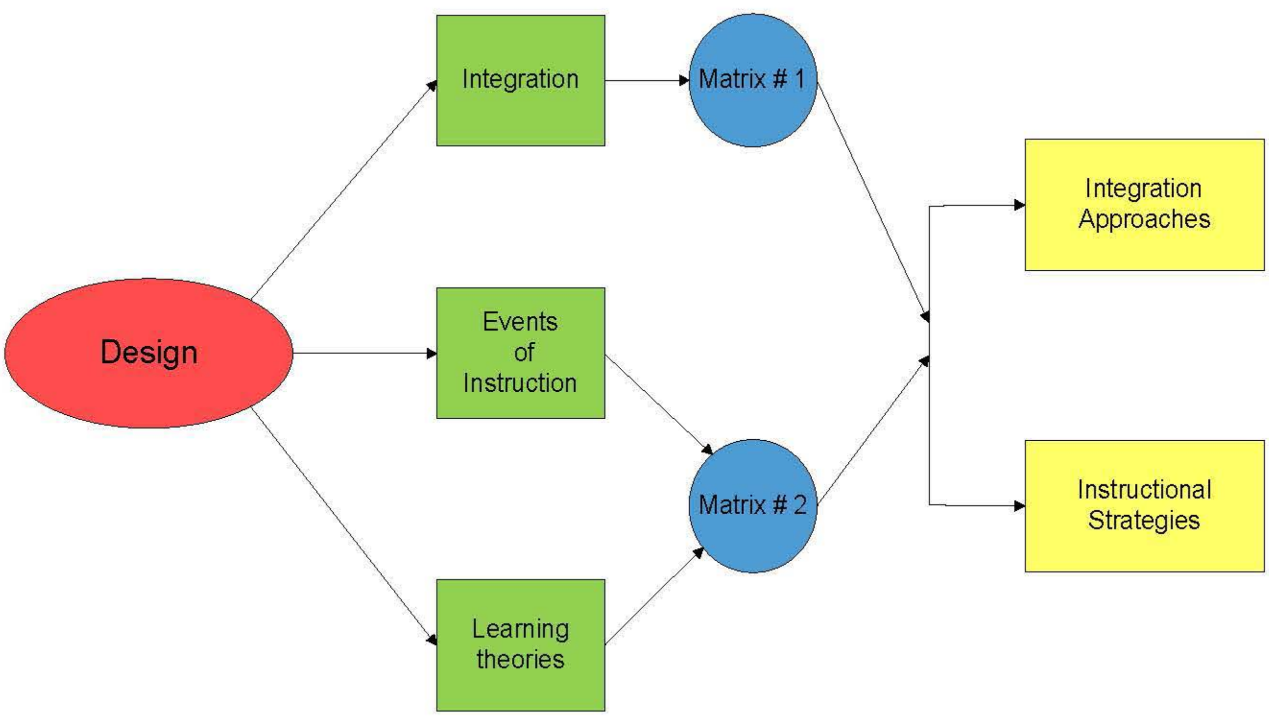

Figure 9: Suggested navigation through Design phase of the Framework.

The framework is designed to make users aware of the consequences and conditions for successful use of media content before the content itself is chosen. The result of the Design stage should be the identified instructional strategies and approaches to integration.

Development and evaluation: These two stages are considered together because they have similar steps to undertake. Sometimes media content should be selected to assist in instruction, while in other cases media content is used to evaluate/assess the learners.

The first step (see Figure 7 on page 90) is to choose the best descriptor for the intended media content. The model's content descriptors were plucked from the list of learning domains (Gagne & Briggs, 1974; M. D. Merrill, 1983; Reiser & Gagne, 1982) and slightly modified. The framework directs designers to use Matrix # 3 (see page 102) in order to choose the best content descriptors for any particular case of instruction. The Framework's content descriptors include: facts and information; concepts and ideas; morals and attitudes; how-to-physical; and how-to-mental. The framework also defines and gives examples of each content descriptor.

After choosing the content descriptor, designers will screen and analyze media (films, TV shows, video games) with the aim to select some pieces/chunks or scenes that match the chosen content descriptor. At this time they must recall the recommendation of the Design stage and take under consideration the chosen integration approaches. The result of these steps should be the development of all instructional materials if the media content is planned for instructional use, or the development of all evaluation/assessment materials if the media content is planned for evaluation purposes, or both (instructional and evaluation materials) if the media content is utilized for instruction and evaluation.

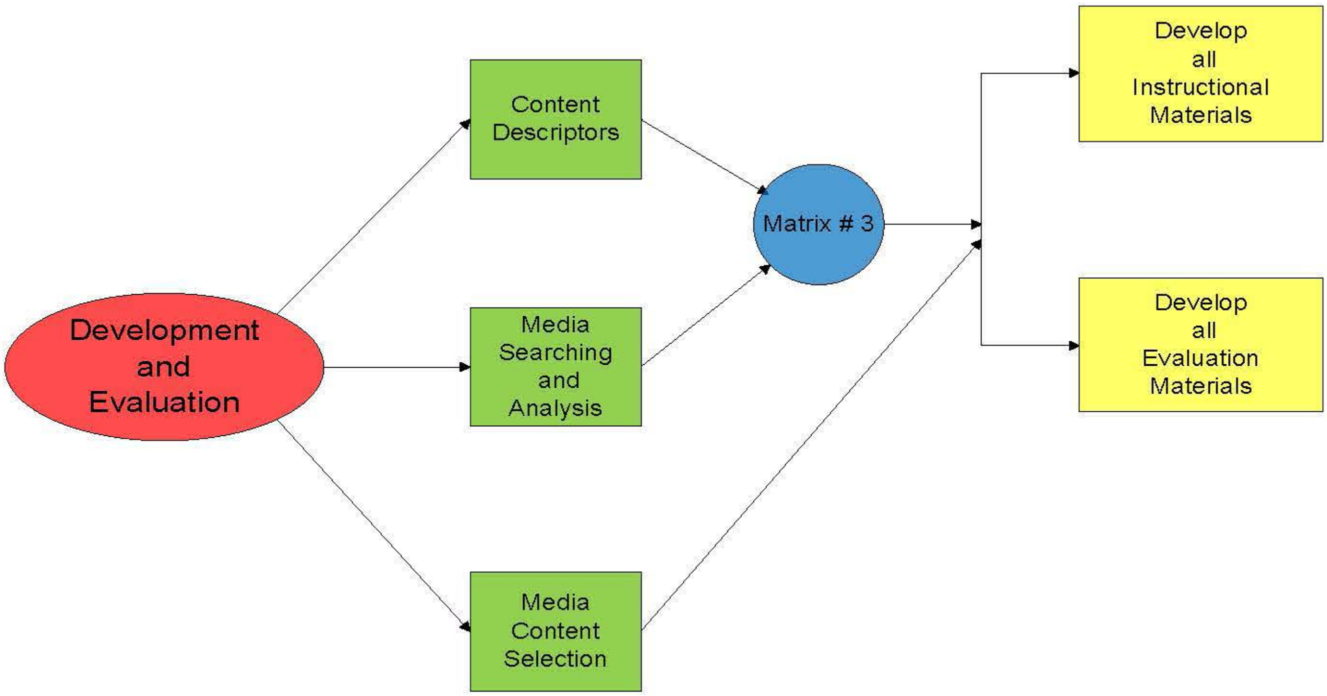

Figure 10: Suggested navigation through the Development and Evaluation Phase.

<u>How to navigate the framework for media content selection:</u> The following is the navigation sequence of the framework.

1. Analyze the leaner, the intended learning, and learning environments. Write learning outcomes and learning objectives. This will wrap up the Analysis stage of your design.

2. As you start the Design stage, start with considerations for subject integration.

a) Go to Matrix # 1: **Questions to be considered for Integration.** First, as you go through the matrix, answer six questions and decide whether you are going to use integration in your instruction. Next, identify the integration approach that you are going to implement. Note, that the listed three integration approaches do not represent the exhaustive list; therefore, fell free to use any other approaches.

b) Next step will be to choose your instructional strategies. Go to Matrix # 2:

Instructional Strategies. First, identify the learning domain that you are preparing your instruction for. Next, choose the event of instruction for which you are using the selected media content. Look at the learning theories and corresponding instructional strategies. Choose instructional strategies that you will be using for your instruction (or evaluation).

The result of the Design stage should be selected instructional strategies and approaches to integration.

3. During the Develop/Evaluation stage, the media content must be selected. To start the process go to Matrix # 3: **Media Content Descriptors**. There, each domain of learning is matched with the examples of what media content should illustrate.

4. Start screening the media of your choice (TV show, films, or video games) and pick the scenes where what is going on the screen matches the needed content descriptor.

5. Finish the media content selection. Note that the selected media content should also correspond to the selected instructional strategies and approaches to integration.

The result of the Develop/Evaluation stage should be selected media clips that you will use for instructional or evaluation purposes.

Table 1:

Matrix # 1: Questions to be Considered for Integration

N	**Questions**	**Yes**	**No**
1.	Is connecting/integrating mathematics and science is something that should be pursuit?		
2.	Do you have any personal experiences with connecting mathematics and science?		
3.	Do you have a colleague who can collaborate with you on integrating mathematics and science?		
4	Do you think you have rich content knowledge of your subject matter with respect to connecting one topic/concept to another, or one branch of your subject to another?		
5.	Do you think you have strong pedagogical content knowledge (the ways of representing and formulating the subject it is comprehensible to others (Shulman, 1986, p. 9)?		
6.	Do you think you are able to recognize and build upon various connections between mathematics and science?		
If you have answered positively ***to at least four questions****, you can go forward and choose (or come with your own) approaches to integration. Otherwise, you might want to skip integration and go to the next step of the framework.*			

Integrated Approaches		
Discipline Specific Integration	**Content Specific Integration**	**Thematic Integration**
This approach to integration involves connecting two topics within one discipline or two branches of mathematics or science. ***Examples:*** 1. Connecting a topic on spatial relationships (left-right, in-front-behind) with geometrical shapes. This is a topic–to-topic integration within mathematics. 2. In the science content areas, an example might involve an environmental issue where integration of geology, chemistry, and biology takes space. This is branch –	This approach involves choosing an existing learning objective from mathematics and one from science. Then an activity is planned that include instruction in each of these objectives. Therefore, infusion of the objectives from each discipline occurs. ***Examples*** 1. Suppose that the learning objective for mathematics is measurement and for science is the study of large animals of the continent of Africa. Then using measuring devices, students can create life size models of the animals on the gym floor. 2. Another example can be the study of simple machines such as a lever in science and proportions in mathematics. As the result,	This approach begins with a theme which then becomes a medium with which all the disciplines interact. ***Examples:*** 1. The theme could be oil spills: in mathematics students will be working with volumes, surface area, and cost of cleanup; in science, they will be working with density (physics, chemistry) and environmental aspects of oil spills (biology).

to branch science integration.	student will derive the formula for the lever and its proportional relationships. **Note**: Not all mathematics and science topics can be integrated.	

Table 2

Matrix # 2: Instructional Strategies

OLT – Objectivist Learning Theories, CLT – Constructivist learning Theories, TSCD - theory of social cognitive development, and MIT-Multiple Intelligence Theory

Learning Outcomes	Events of Instruction	Learning Theories	Instructional Strategies
Verbal Information	5 Providing learning guidance 6 Eliciting performance 9 Enhancing retention/transfer	OLT	1. Provide and clarify the hierarchical relationships among ideas 2. Use associational techniques (e.g., mnemonics, images, analogies) 3. Use organizational techniques (e.g., clustering, chunking) 4. Use spaced practice 5. Provide cues for effective recall and generalization
		CLT	1. Use novelties, differences 2. Present moderate complexities 3. Use motion, changes, bright images
		TSCD	1. Engage students 2. Motivate students to pursue the instructional goals
		MIT	1. Provide opportunities to use active imagination 2. Provide opportunities for focusing and concentration
Intellectual Skills	4.Presenting the stimulus materials 6. Eliciting performance 7. Providing feedback	OLT	1. Provide examples that clearly embody all the necessary (critical) characteristics of the object, event, or phenomena 2. Have the learner examine the non-examples as well
Discrimination		CLT	1. Present information in a variety of ways to encourage learners to view the knowledge base from multiple viewpoints 2. To improve retention- sequence screens and present related materials
		TSCD	1. Engage and motivate students to pursue the instructional goals 2. Provide opportunities for reciprocal teaching
		MIT	1. Provide opportunities do debate and storytelling 2. Provide opportunities to use active imagination 3. Provide opportunities for focusing and concentration

	Concepts	4.Presenting the stimulus materials 6. Eliciting performance 7. Providing feedback	OLT	1. Present clear examples 2. Guide learners to discover the underlying concepts 3. Present matched non-examples 4. Guide learners to discover the non-relevant attributes of the concepts 5. Encourage learners to think of their own examples of the concepts 6. Use analogies 7. Provide new information by changing cognitive component
			CLT	1. Revision from different conceptual perspectives 2. Use multimedia to provide visual context
			TSCD	1. Provide opportunities for scaffolding 2. Provide opportunities for reciprocal teaching 3. Access the zone of proximal development
			MIT	1. Provide opportunities for debate and storytelling 2. Provide opportunities to use active imagination 3. Provide opportunities for emotional introspect
	Rules/Principles		OLT	1. Guide learners in reviewing the concepts underlying the principles procedure 2. Present learners with the statement of the principle/procedures 3. provide subsequent examples of the principle's application 4. Guide learners to identify the features of a situation that suggest a particular principle/rule/should be used
			CLT	1. Revisiting context at different times 2. Actively using what is learned 3. Allow student to assume practitioners and professional roles and act out situations that they find in real world 4. Students research the topic and can present findings to the class
			TSCD	1. Provide opportunities for scaffolding 2. Provide opportunities for reciprocal teaching 3. Create a dialog between students and a teacher beyond answering questions and engage in the discourse
			MIT	1. Provide opportunities for cooperative learning 2. Provide opportunities for group projects 3. Provide opportunities to use active imagination

Problem Solving		OLT	1. Provide problems not previously encountered 2. Discompose the problems into sub-problems
		CLT	1. Provide authentic real world problems 2. Support problems with visual images to help learners construct mental images and visualize activity 3. Present alternative ways of representing problems 4. present new problems and situations that different from the conditions of the initial instruction
		TSCD	1. Students and a teacher play untraditional roles as they collaborate with each other 2. The physical classroom provides a setting for peer instruction, collaboration, and small group instruction 3. Classroom becomes a community of learning
		MIT	1. Provide opportunities for high-order reasoning 2. Provide opportunities for problem solving
Cognitive Strategies		OLT	1. Frequently present learners with novel and challenging problems
		CLT	1.Instruction must be concerned with the experiences and contexts that make the student willing and able to learn 2. Instruction should be designed to facilitate extrapolation and or fill in the gaps
		TSCD	1. Students and a teacher play untraditional roles as they collaborate with each other 2. The physical classroom provides a setting for peer instruction, collaboration, and small group instruction 3. Classroom becomes a community of learning
		MIT	1. Use educational games and multimedia presentations
Attitudes/Motor Skills		OLT	1. Provide models 2. Reinforce proper behavior 3. Provide verbal guidance 2. Provide and reinforce practice
		CLT	1. Elicit purposeful emotional involvement 2. Present persuasive messages in a credible manner
		TSCD	1. Code modeled behavior into words, labels, or images for better retention 2. Individuals are more likely to adopt a modeled behavior if it results in outcomes they value.
		MIT	1. Use educational games and multimedia presentations

Table 3

Matrix # 3: Media Content Descriptors

Domains of Learning	**What the selected media should do/depict/illustrate…**
Facts and Information/ Verbal/Discrimination	1. Illustrate the facts 2. Provide simple information ***Example1:*** *A scene from a TV show displays objects of various sizes (early mathematics)* ***Example 2:*** *A scene from an animated feature movie shows different types of clouds or plants (science)*
Concepts and Ideas/Concepts, Rules and Principles	1. A movie clip, a scene from a video game, or a TV show clip illustrates the physics principle or the mathematics concept. Those scenes and clips also allow to analyze them against the background of the fundamental science and mathematics laws and rules. The impact of the media content is being able to understand why, in reality, the scene could or could not have occurred as depicted in the film, video game, or TV show, what the director got right and what he got wrong, ***Example 1:*** *Discuss the principles of physics using scene clips from popular action and sci-fi movies. For example, the law of gravitation as used (or missed) in Independence Day, or conservation of momentum in Tango and Cash(science)* ***Example 2:*** *Discuss the laws of speed and acceleration in Speed 2.*
Intellectual: How to/ Problem Solving and Cognitive Strategies	*1.* Media content provide enough information to pose a problem that learners need to solve 2. Media content make use of science and mathematics laws and principles that are embedded into plots and actions. Learners have an opportunity to use the information provided by the media content to do actual computations and reason whether what happened on the screen could have happened in real life. ***Example1:*** *In Speed 2 there is a scene where a large cruise ship crashes into the waterfront of a busy resort town, hitting other boats, docks, the shoreline, and ultimately buildings. As the ship approaches the shore and hits various things, it begins to decelerate and people and objects onboard are thrown violently toward the bow, two men on the bridge even thrown through the windows onto the forward deck. All of the mayhem is seemingly in agreement with the audience's 'gut' feeling of what would happen as a consequence of the deceleration of the ship. However, throughout*

	the scene we are given frequent views of the ship's digital speedometer on the bridge. Since the crashing of the ship is shown in real time, by simply noting the time of each speed reading as the ship approaches the shore and finally comes to a stop, we can directly compute the deceleration, *using the simple formula:* *deceleration = speed change/time change* *We see that the ship's deceleration was actually quite low; therefore, the widespread tumbling about of things and people on the ship would not have occurred.* Borrowed from (Efthimiou & Llewellyn, 2004) ***Example 2:*** *In Armageddon a huge, errant asteroid the size of Texas is on a collision course with Earth. A team of oil well drillers is dispatched via a pair of space shuttles to intercept the asteroid, drill a hole in it at the right place, lower a large nuclear bomb into the hole, and subsequently blow the asteroid into two large pieces. Using numbers provided in the film, introduce the students to the idea of making reasonable approximations. For example, the asteroid is, we are told, the size of Texas, so we assume Texas is a square whose surface area equals that of the state, then approximate the asteroid as a cube, each of whose sides equals the surface area of the state. Multiplying the volume of the cube by the average density of Earth gives us a decent estimate of the mass of the asteroid. Assuming the bomb as being equal to 100,000 Hiroshima bombs provided an estimate of the energy available for the job. Then, assuming all of that energy became kinetic energy equally divided between the two pieces of the asteroid (i.e., ignoring the energy needed to break the asteroid into two pieces), we can readily compute the distance the pieces have moved perpendicular to their original direction of motion by the time they reach Earth. As noted in the diagram, the deflection for each piece is only a bit over 200 meters. So, instead of being hit by one Texas-size asteroid, Earth will be hit by two half-Texas-size asteroids few city-blocks apart*! (Efthimiou & Llewellyn, 2004)
Moral/Attitudes	1. Illustrate and depict how scientists and mathematicians work and collaborate with each other. ***Example1:*** *A scene from a movie "Beautiful Mind" illuminates the major character devotion to his field of research.*
Physical: How to/ Motor Skills	1. Illustrate how to build something, do experiments, conduct research, behave on an alien planet, etc. Some of these scenes can be incorrect from the scientific point of view. ***Example 1****: It is a blind mistake to take of the helmets, even if you think the atmosphere is safe. If later you plan to collect biological samples and compare*

	them with human DNA, as, for example, the crew does in the movie Prometheus, it is going to ruin your research. Humans are constantly flaking off bits of skin and breathing out droplets of moisture filled with cells and fragments of cells, and taking off a helmet could irrevocably contaminate the environment.

Module Development

During the final step of the study's Phase One, the researcher used the first iteration of the framework to develop a short instructional module that incorporated the repurposing of popular media. This instruction focused on early mathematics (K-2) and the repurposing of full-feature children animated films. The goal of this step was the development of a documentation to record the process for media content selection that was later used to modify and revise the framework.

A binder was developed with 4 sections for each major stage of the Framework: Analysis, Design, Development and Evaluation. A daily log was inserted into each section and filled out during the design of the module. The log documented the time, the activities, resources, thoughts and lessons learned during the process. During this stage, the researcher became a designer and she used daily logs to collect data that would be later analyzed and used to revise the Framework.

During the module development process the researcher assumed the role of a Pre-school teacher who needed to select media content for her mathematics class. The mathematical topic was one of the spatial relationships topics, namely - "in front-behind".

Analysis stage: Analysis stage involved the analysis of learners' characteristics, the content to be learned and the learning environment. The completed daily log for the Analysis stage can be found in Appendix B. The time required for this stage was only one (1) hour since the researcher knew her learners, the content to be learned, and the learning environment well even before the module development process has started. The situation may be different if a designer is new to a certain type of learners or learning environments; then the analysis stage would take longer.

The outcome of the Analysis stage was the identification of the learning objectives and learning outcomes. The desired outcome fitted into "Intellectual Skills" learning domain because the learners must perform some unique cognitive activities with the learning subcategory being the "Concrete Concepts": concept of "in-front-behind".

From the analysis stage, two important implications for the framework have resulted.

1. First, the step that involves the identification of learners' characteristics can be skipped if the designer/instructor already know her learners well and provided instructions to them before. This step can also be omitted if the Framework is used as a complementary to some widely-used existing instructional models. For example, if Dick and Carey model is used, then the whole analysis stage would be done before the media content selection process is implemented.

2. In addition to the writing of general learning objectives, a separate learning objectives should be identified that address the desired media content. Some examples might include but are not limited to the following:

a) After watching the selected media content students should be able to describe what is happening on the screen using the mathematical terms correctly.

b) After watching the selected media content students should be able to apply a learned mathematical concept to the situation on the screen.

c) After watching the selected media content students should be able to use the information provided by the media content to do actual computations and reason whether what happened on the screen could have happened in real-life situations.

Design stage: The design stage started with filling out Matrix # 1 and deciding on integration options (the completed daily logs for the Design stage can be found in Appendix B). The researcher answered positively to five questions out of six (see Table 4 on page 107). The researcher answered negatively to the questions about the colleague who she could collaborate with on integration. Since the researcher assumed the role of an elementary teacher who usually teachers all subjects, the collaboration with another teacher is not essential.

The unit topic of interest was the spatial relationships and the researcher chose the discipline-specific integration where she would be able to integrate the current topic of the lesson (in-front-behind) with other spatial topics (left-right, near- far, and so forth). The options for integration were recorded in Matrix # 1 in bold italic (see Table 4).

Table 4

Matrix # 1: Questions Considered for Integration for Module Development

N	**Questions**	**Yes**	**No**
1.	Is connecting/integrating mathematics and science is something that should be pursuit?		
2.	Do you have any personal experiences with connecting mathematics and science?	**X**	
3.	Do you have a colleague who can collaborate with you on integrating mathematics and science?		**X**
4	Do you think you have rich content knowledge of your subject matter with respect to connecting one topic/concept to another, or one branch of your subject to another?	**X**	
5.	Do you think you have strong pedagogical content knowledge (the ways of representing and formulating the subject it is comprehensible to others (Shulman, 1986, p. 9)?	**X**	
6.	Do you think you are able to recognize and build upon various connections between mathematics and science?	**X**	
If you have answered positively ***to at least four questions****, you can go forward and choose (or come with your own) approaches to integration. Otherwise, you might want to skip integration and go to the next step of the framework.*			

Integrated Approaches		
Discipline Specific Integration	**Content Specific Integration**	**Thematic Integration**
This approach to integration involves connecting two topics within one discipline or two branches of mathematics or science. ***The integration should involve connection between different spatial relationships topics (left-right, in-front-behind, near-far, etc.).***	This approach involves choosing an existing learning objective from mathematics and one from science. Then an activity is planned that include instruction in each of these objectives. Therefore, infusion of the objectives from each discipline occurs.	This approach begins with a theme which then becomes a medium with which all the disciplines interact.

After the decision about integration was made, the researcher needed to choose instructional strategies. For this, she turned to Matrix # 2 to work on the events of instructions and the learning theories. During the Analysis stage, the learning domain "Intellectual skills - Concrete concepts" was identified; therefore only the part that relates to this learning domain of Matrix # 2 is shown in Table 5 on page 110.

The next step was to select the events of instruction that the selected media content would be used for. The researcher decided on three events:

- Present the material to be learned
- Elicit performance "practice": let the learner do something with the newly acquired behavior, practice skills or apply knowledge.
- Enhance retention and transfer: inform the learner about similar problem situations, provide additional practice. Put the learner in a transfer situation.

The selection of the events of instruction was followed by the matching of each event with the most appropriate learning theory and corresponding instructional strategies. The learning theories were chosen for each event with subsequent selection of the more specific instructional strategies for each general strategy listed in original Matrix # 2. See Table 5 on page 110 for details. It should be noted that the reasoning behind the learning theory selection that best fits to each instructional event was based on the findings from the literature review and the researcher's own beliefs that for the novice learners (or learners who've just started a new topic or concept) the behaviorist and cognitivist approaches should be applied, and for advanced learners (or learners who are already familiar with the concept), constructivist strategies are more appropriate. With this approach the researcher was able to draw from a larger number of strategies.

A decision where to include integration had to be made as well. The researcher decided that it is more beneficial for students to incorporate integration later into the lesson, when they already have had an opportunity to grasp a new concept and practice with it; therefore, integration was included into the “Enhance retention and transfer” event of instruction. Table 5 lists the learning theories that were chosen for each instructional event, displays specific instructional strategies for each event, and provide description about how and when the selected type of integration will be implemented.

Table 5

Matrix # 2: Instructional Strategies for Specific Events of Instruction

<table>
<tr><td rowspan="6">Intellectual Skills/ Concepts</td><td rowspan="2">4. Present the stimulus materials</td><td>OLT</td><td>1. Present clear examples- Let children watch a short movie segment # 1. Explain how the concept of "in-front-behind" is illustrated there.
2. Guide learners to discover the underlying concepts Let children watch a short animated movie segment # 2 and guide them to observe and explain the same concept using appropriate mathematical terms.
4. Guide learners to discover the non-relevant attributes of the concepts
Let children watch a short animated movie segment # 3 and let them to discover and discuss that big, small, and various colored (non-relevant attributes) objects, animals or people can either be in-front or behind each other.</td></tr>
<tr><td>TSCD</td><td>1. Access the zone of proximal development
The first screening event should be completely directed by the teacher. During the second screening event, students actively participate in discussion and answer questions. During the last screening event, the guidance should be minimal.</td></tr>
<tr><td rowspan="2">6. Elicit performance practice": let the learner do something with the newly acquired behavior, practice skills or apply knowledge.</td><td>CLE</td><td>1. Revision from different conceptual perspectives
2. Use multimedia to provide visual context
3. Encourage learners to think of their own examples of the concepts
During the next screening event (segment # 4), divide the whole class into groups. Each group will watch the media content and then convene for discussion during which they will record what they observed in relation to the learned math concept and prepare answers to questions posed by the teacher.</td></tr>
<tr><td>TSCD</td><td>1. Provide opportunities for scaffolding
2. Provide opportunities for collaboration
During this screening event, students will collaborate with each other and assume different roles such as a group leader, a reporter, a recorder, and so forth.</td></tr>
<tr><td rowspan="2">9. Enhance retention and transfer: inform the learner about similar problem situations, provide additional practice. Put the learner in a transfer situation.</td><td>CLT</td><td>1. Provide opportunities for debate and storytelling
Invite children to watch a movie segment # 5 and then ask them to create their own continuation of the scene where they can actively use and utilize not only a current math concept "in-front-behind" but all other spatial relationships – <u>provision for integration</u></td></tr>
<tr><td>MIT</td><td>2. Provide opportunities to use active imagination
Ask them to draw their own "animated scenes" that illustrate the continuation of the story and make use of different spatial relationships.</td></tr>
</table>

From the Design stage, four important implications for the framework have resulted.

1. It became clear that a complete solution for integration options cannot be accomplish during the Design stage. Until the media content is selected, it is almost impossible to judge what other rich opportunities for integration exist. Therefore, a designer needs to come back to integration decision one more time after the media content has been selected.

2. Matrix # 2 of the first Framework iteration guided a designer to choose among the four learning theories for all events of instruction for any specific learning outcome. It turns out not to be practical. Seeing the framework in action, prompted the researcher to realize that different learning theories may better work for any given event of instruction; therefore, a learning theory (s) and corresponding instructional strategies must be chosen for each event of instruction.

3. The last result/observation is related to the instructional strategies. The framework's first iteration listed very general instructional strategies for each learning theory. In practice, when a designer knows who the learners are, what the learning content is, and the learning environments, it is desirable that specific and more detailed instructional strategies are listed for each event of instruction.

4. Finally, integration should be incorporated into specific instructional strategies for a chosen event of instructions.

Development and Evaluation Stage: This stage started with the selection of the media content descriptors and utilized Matrix # 3. During the earlier stages of the module development, it was finalized that the domain of learning was "Concepts". But the selected strategies suggest that we may also want to consider the learning domain “Intellectual - problem solving” since one of the chosen strategies provides for posing a problem for the students. Therefore, only a part of Matrix # 3 that relates to these learning domains is displayed below. According to Table 6, five scenes from animated movies should be selected to accommodate the chosen strategies for three events of instruction. Table 6 on page 113 describes in bold what each selected media content should do/depict/illustrate in relation to the mathematics concept “in-front-behind”.

Table 6

Media Content Descriptors Identified for Instructional Module

Domains of Learning	**What the selected media should do, depict/illustrate…**
Concepts and Ideas/Concepts, Rules and Principles	A movie clip, a scene from a video game, or a TV show clip illustrates the physics principle or the mathematics concept. Those scenes and clips also allow analyze them against the background of the fundamental science and mathematics laws and rules **<u>Scene # 1</u>: This segment should depict a scene where objects or living beings positions in-front and behind each other.** **<u>Scene # 2:</u> This segment should depict a scene where objects or living beings positions in-front and behind each other.** **<u>Scene # 3:</u> This segment should depict a scene where objects or living beings are positioned in-front and behind each other. In contrast to the first two scenes this segment should include objects or human beings of different sizes, heights, weights, etc. (non-relevant attributes) that can be positioned in either position. For example, a big car can be in front of the smaller car and vice versa.**
Intellectual: How to/ Problem Solving and Cognitive Strategies	Media content provide enough information to pose a problem that learners need to solve **<u>Scene # 4:</u> This segment should depict a scene where objects or living beings positions in-front and behind each other. But the scene should include many other details, so it is not that obvious from the first glance and students need to watch the scene multiple times in order to record all examples of the concept. After watching the media content, they would also need to answer several questions that require utilization of their solving skills.** **<u>Scene # 5:</u> This segment provides opportunities to apply a new concept of "in-front- behind" as well as all other spatial topics (left-right, long-short, near – far), etc. The scene should provide opportunities to fantasize and create their own ending of the scene.**

After the content descriptors were identified, the lengthy process of screening started (see daily logs in Appendix B for details). A screening was performed on a selected group of 5 feature-length children animated movies. Using purposive sampling, movies were selected that are most commonly watched by children. From this group, additional selection criteria were used including movies released in theaters for the first time after 1990 and movies rated in the top 10 animated films or top 25 movies. The movies selected represent those with either sustained or current popularity (see Table 7on page 115 for the movies screened). The movies were watched, and information was recorded that was relevant to each required content descriptor: times frames, the content included, and character descriptions.

Table 7

Analyzed Animated Films

Original Release	**Movie Title**
Pixar, 2006	Cars
Pixar, 2003	Finding Nemo
Pixar, 1995	Toy Story
PDI/DreamWorks, 2001	Shrek
Pixar, 2008	Wall-E

The process of screening and analyzing the movies was followed by the last step in Development-Evaluation stage: media content selection. It resulted in selection of five scenes that match media content descriptors identified earlier. Table 8 on page 117 reflects this final selection. The column on the left lists the content descriptors from Table 7, while the middle column describes what the selected media really depicts. The right column records the name of the films and time frames of selected scenes.

Table 8

Media Content Selection

What selected media should do, depict/illustrate…	Description of selected movie scenes	Names of Films and Time Frames
Scene # 1: This segment should depict a scene where objects or living beings positions in-front and/or behind each other.	On the way to the tie-breaker race in Los Angeles, California, Lightning McQueen, a young race car gets lost in a little town called Radiator Springs on the old Route 66 road, and is chased by the sheriff. He is driving in–front of Sheriff and Sheriff is behind Lightning McQueen.	Cars (2006) 23:45 – 24:22
Scene # 2: This segment should depict a scene where objects or living beings positions in-front and/or behind each other	Arriving at Sydney Harbor, Marlin and Dory get a major assist from Nigel, a friendly pelican who has also heard the amazing stories of this brave clown fish searching for his son. Marlin is in-front of Dory, and Dory is in-front of Nigel and behind Marlin, and Nigel is behind Dory.	Finding Nemo (2003) 01:17:19 – 01:17:38
Scene # 3: This segment should depict a scene where objects or living beings are positioned in-front and behind each other. In contrast to the first two scenes this segment should include objects or human beings of different sizes, heights, weights, etc. (non-relevant attributes) that can be positioned in either position. For example, a big car can be in front of the smaller car and vice versa.	When Buzz Lightyear, a space-ranger, takes Woody's place as Andy's favorite toy, Woody doesn't like the situation and gets into a fight with Buzz. Accidentally Buzz falls out the window and Woody is accused by all the other toys of having killed him. Other toys confront him. Some big and small toys are standing in-front and behind each other.	Toy Story (1995) 25:50 – 27:27
Scene # 4: This segment should depict a scene where objects or living beings positions in-front and behind each other. But the scene should include many other details, so it is not that obvious from the first glance and students need to watch the scene multiple times in order to record all examples of the concept. They would need to answer several questions	Shrek is grumpy, smelly and ugly ogre, living peacefully in a swamp. One night, he suddenly finds his land has been squatted by a mass of fairy-tale creatures (Pinocchio, the three little pigs, Peter Pan, Snow White, Cinderella, among others), who have been banished by the evil Lord Farquaad. They all facing	Shrek (2001) 14:02 – 15:28

after watching that require utilization of their solving skills.	Shrek and positioned in-front and behind each other. There are many of them in this scene. Example of questions to ask: 1. Who is behind Donkey? 2. Who is in- front of the horse? 3. Who is in-front of the bears but behind them? 4. Is there anyone in-front of the three little pigs?	
<u>Scene # 5:</u> This segment provides opportunities to apply a new concept of "in-front- behind" as well as all other spatial topics (left-right, long-short, near – far), etc. – provision for integration. **The scene should provide opportunities to fantasize and create their own alternative ending of the scene.**	On the Axiom, the ship's original human passengers and their descendants have suffered from severe bone loss due to long term effects of microgravity and become morbidly obese after centuries of living in a low-gravity environment and relying on the ship's automated systems for most tasks. The ship's captain, McCrea, mostly leaves control to the robotic autopilot, Auto. In this scene, robots assist him with his morning routine. There is an opportunity for students to apply other spatial relationships describing what is happening in this scene.	Wall – E (2008) 41:10 – 48:38

This selection wrapped up the Development-Evaluation stage and it resulted in ready-to-use instructional and evaluation materials: five segments from full-length children animated films that can be used for instruction on early mathematics topic “in- front- behind” and its integration with other spatial topics.

As was anticipated earlier, the real process of watching the media content brought about other unexpected opportunities for integration. For example, the scene # 4 from Shrek contains a lot of characters from various fairy tales; therefore, it becomes natural to incorporate a discussion about what fairy tales they are coming from, their names, character traits, etc. Thus, this media content presents a natural way to integrate Language Arts into mathematics lesson, and hereby, enrich students learning.

Decisions and Revisions

After the instructional module on early mathematics has been developed, the lessons and implications from this process were used to modify the framework. The content of the Matrices was not changed (Table1, Table 2, and Table 3) and the Framework graph was left intact. The changes were mostly related to the navigation procedure; therefore, displayed below are the unaltered Framework graph and the modified navigation guidelines (modifications and additions are in Italic).

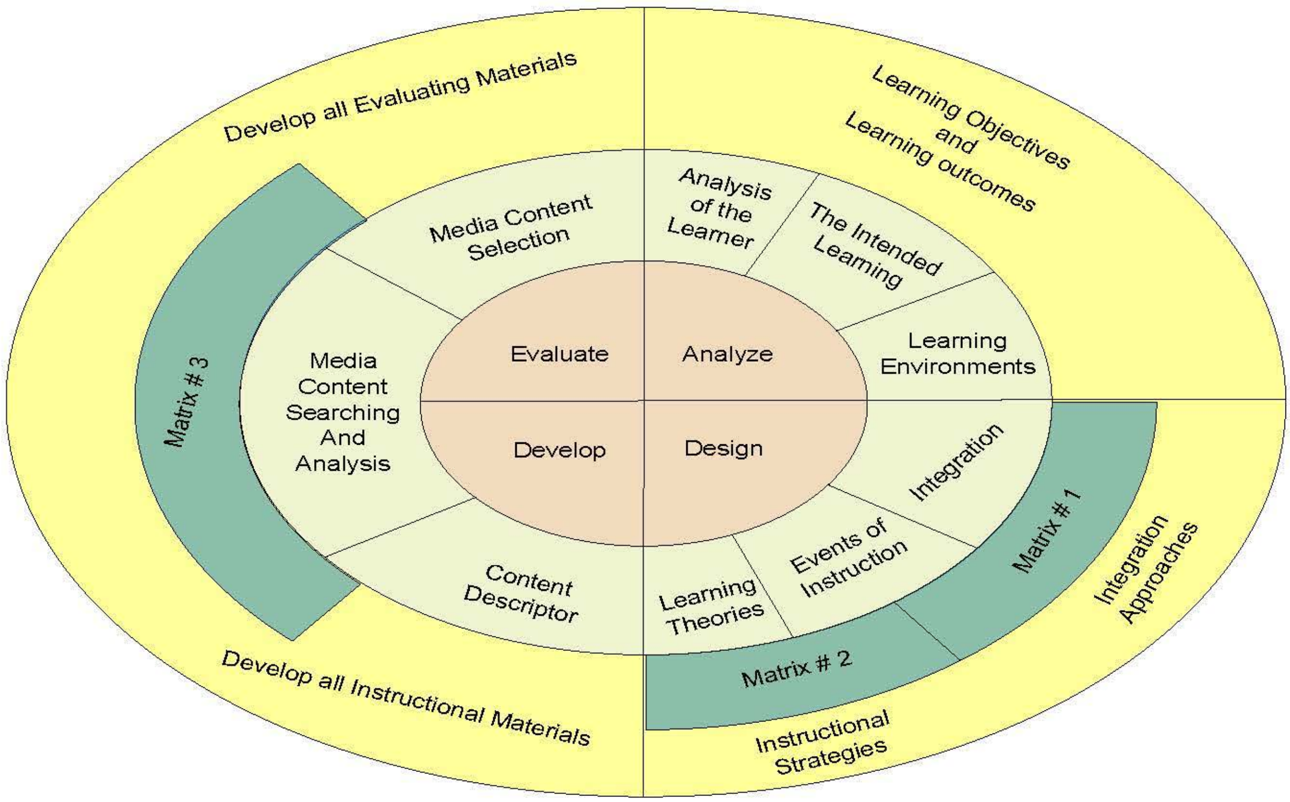

Figure 11. Framework after Module Development

<u>How to navigate the framework for media content selection</u>

1. Analyze the leaner, the intended learning, and learning environments. *Analysis of the learners can be skipped if the designer/instructor already knows her learners well and provided instructions to them before. This step can also be omitted if the framework is used as a complementary to some widely-used existing instructional models and this step is done before the media content selection.*

Write learning outcomes and learning objectives. *In addition to the writing of general learning objectives, a separate learning objectives should be identified that address the desired media content. General examples include but are not limited to the following:*

a) After watching the selected media content students should be able to describe what is happening on the screen using the mathematical terms correctly.

b) After watching the selected media content students should be able to apply a learned mathematical concept to the situation on the screen.

c) After watching the selected media content students should be able to use the information provided by the media content to do actual computations and reason whether what happened on the screen could have happened in real-life situations.

This will wrap up the Analysis stage of your design.

2. As you start the Design stage, start with considerations for subject integration.

a) Go to Matrix # 1: **Questions to be considered for Integration.** First, as you go through the matrix, answer six questions and decide whether you are going to use integration in your instruction. Next, identify the integration approach that you are going to implement. Note, that the listed three integration approaches do not represent the exhaustive list; therefore, fell free to use any other approaches. *You might need to return to Matrix # 1 one more time, during the actual media content selection to look for other rich opportunities for integration.*

b) Next step will be to choose your instructional strategies. Go to Matrix # 2: **Instructional Strategies.** Identify first the learning domain that you are preparing your instruction for. Next, choose the event of instruction for which you are using the selected media content. Look at the learning theories and corresponding instructional strategies. Choose instructional strategies that you will be using of your instruction (or evaluation). *Since different learning theories may better work for any given event of instruction; it is preferable to* *choose a learning theory and corresponding more specific instructional strategies for each event of instruction. Finally, integration should be incorporated into specific instructional strategies for a chosen event of instructions.*

The result of the Design stage should be selected instructional strategies and approaches to integration.

3. During the Develop/Evaluation stage, the media content must be selected. To start the process got to Matrix # 3: **Media Content Descriptors**. There, each domain of learning is matched with the examples of what media content should illustrate.

4. Start screening the media of your choice (TV show, films, or video games) and pick the scenes where what is going on the screen matches the needed content descriptor. *Look for additional opportunities for integration.*

5. Finish the media content selection. Note that the selected media content should also correspond to the selected instructional strategies and approaches to integration.

The result of the Develop/Evaluation stage should be selected media clips that can be used for instructional or evaluation purposes.

Chapter 5: Phase Two: Framework Validation

Introduction

Every new model should be undoubtedly validated. The most used validating strategies are expert review, usability documentation, component investigation, field evaluation, and controlled testing (Gustafson & Branch, 2002a; Richey, 2005; Tracey & Richey, 2007; Weston, McAlpine, & Bordonaro, 1995). The first three strategies are examples of so-called internal validation.

As explained by Richey (2005) , internal validation focuses on the integrity of the model and its use. Internal validation studies are typically conducted during model construction or in the early stages of use. They provide data to support each component of the model, as well as the relationship between the components and the processes involved.

As mentioned earlier, expert review is one of the strategies of internal validation and the most used. It is a process “whereby ID experts critique a given model in terms of its components, overall structure, and future use” (Richey, 2005, p. 178). This is a cyclical process of model review and critiquing based on pre-specified criteria, and subsequent model revision based on the data. Often Delphi techniques are employed as a framework for achieving consensus among the experts/participants. Many of the best examples of expert review validations are found in doctoral dissertations.

For example, Sleezer (1991) developed and validated a Performance Analysis for Training (PAT) model using expert review methods. She used experts in training needs assessment to evaluate the content and face validity of the PAT model. Tracey (2001) used expert review in part to validate her newly developed model. This model provided a way to incorporate a consideration of multiple intelligences into a standard ISD orientation.

Many expert review studies collect data from persons serving as subject-matter experts and employ strategies such as in-depth interviews (Cowall, 2000) or Delphi techniques (Tracey, 2001).

Weston et al. (1995) used another approach that utilized the writings of experts as a source of validation data. The authors constructed and validated a model directed toward the evaluation phase of the ID process. Their model emphasized four components of data collection and revision: participants, roles, methods, and situations. Weston et al.'s expert review approach was based upon content analyses of 11 commonly cited texts in instructional design or formative evaluation. These texts were reviewed to identify descriptions of the four key components in their formative evaluation model. This first level provided a basic level of expert support for the model. These descriptive segments were then analyzed to determine the experts' support for the more detailed components of the model in question. The results were presented in both a narrative fashion as well as a qualitative summary to show the level of support for each facet of model's components.

The Purpose of Phase Two

The purpose of Phase Two of this study was to conduct an expert review to evaluate, modify, and revise the Framework developed during Phase One. McKenna (1994, p. 1221) defines experts as "a panel of informed individuals"; hence the title "experts" being applied.

Procedures and Instrumentation

Phase Two consisted of a packet that was emailed to each expert. This packet included three documents: (1) an introductory letter with directions for this study and the overall study statement, (2) the second iteration of the Framework (after the module development), and (3) in-depth Survey to be filled out by experts. This survey used some of the questions and language from chapter by Richey (2005, p. 174).

The purpose of this survey was to provide data to support each component of the developed Framework, and relations between its components. The following are the survey's questions:

1. What are your general comments and suggestions about the framework?
2. What are your general thoughts about the need of such framework for media content selection?
3. What are your general comments about the framework's steps and their sequence?
4. What is your general opinion on the usage of the framework for various projects and environments?
5. What are your general thoughts about implementation of the framework by both novice and expert designers?

Population and sample: The panel of three experts used for framework validation was selected via a review of Universities professors in the field of Instructional Design favorably responding to written request to participate in an expert review evaluating The Media Content Selection Framework due to their areas of expertise in the field of Instructional Design and Technology.

Dr. Monica W. Tracey, Associate Professor of Instructional Technology in the College of

Education at Wayne State University was asked to participate due to her research that focuses on theory and design-based research of interdisciplinary design including design thinking, designer reflection and designer decision-making.

Dr. Michael Grant, associate professor in the Instructional Design and Technology Program at the University of Memphis was invited to participate due to his research on design of learning environments and the key learner characteristics.

Dr. Rob Branch, Professor and Head of the Department of Educational Psychology and Instructional Technology at the University of Georgia, was invited to participate due to his research that focuses on student-centered learning and his outstanding leadership in instructional design and visual literacy.

Expert Responses

Experts were given ten days to respond to five questions listed in the packet sent to them. Their responses were recorded verbatim and then grouped together based on the question asked, the part of the framework they addresses and miscellaneous categories for additions feedback. The expert responses quoted in this section are referenced by the expert last name and coded per line number in Appendix C.

Factors identified. The factors that emerged from the original five questions were categorized into the following topics: a) amending the framework steps and their sequence, b) ability of a novice /expert to work with the framework, c) general comments and suggestions, d) the usage of the Framework in various learning environments, e) areas for revision.

Amending the framework steps and sequence. In responses to the third question regarding the framework steps and their sequence, Branch generally approved the sequence by stating:

> *I think the steps in sequence are appropriate. I did, at first, wonder why implementation was omitted while analysis, design, development and implementation were included (lines79-80).*

Tracey suggested that consideration should be given to the media options available for specific learning environments. She wrote:

> *During the analysis step, I think it is important to include analyzing the media options. In other words, what is available for you to use in the learning context? If you don't know this up front, the rest of the framework doesn't matter. The media in this framework isn't addressed in the design phase which is a problem (lines 73-76)*

In addition, Tracey commended the inclusion of integration approaches but thought that two matrices can be fused into one:

> *I do like the idea of integration approaches considered prior to instructional strategies. Matrix 2 is not specific enough, and the more I look at it the more I wonder if Matrix 2 and 3 could be combined. I don't know, but it is something to consider (lines 76-78).*

Grant recommended identifying the "nature" of the proposed Framework from the very beginning. He wrote:

> *As I read through the description of the research problem and then into the introduction for "The Framework," I was confused as to whether this was an instructional design model or media selection or instructional development model. This was reinforced when reading through the analysis and design phases of the framework (lines 41-45).*

In addition, Grant suggested including some cues to help the users to follow the sequence of the Framework

> *Sequences are rarely depicted in circles/oval, because these visually communicate relationships or parts of a whole. If there is a specific sequence, then visual cues should be added in order to interpret the sequence (lines39-41).*

General comments and suggestions. The experts provided relatively positive general comments about the Framework. Branch stated that his "initial impression is that the idea is appropriate for our field and such a framework is important for instructional designers and media developers" (lines 18-19). Grant wrote: "I could see where you were trying to get to with this framework" (line 2). Tracey claimed "I understand what you are attempting to do and commend you in doing so" (line 7).

However, experts expressed their concern about the complexity of the framework. Branch wrote:

> *The initial reaction of a practitioner or teacher of math or science for that matter would likely find this extremely complex and thus, not even attempt to use (lines 20-21)*

Tracey shared her own experience in terms of the complexity and difficulty to follow all the steps:

> *I have designed for over 25 years in numerous design situations and have never had the time to use something with so many steps and so many questions etc. to consider. If I were to use this, I would need the analysis step to be considerably developed because so many decisions are made during that phase (lines 90-93)*

In addition, Tracey commented on the visual flow of the framework and questioned whether the depicted graphical representation of the Framework reflects the real – life practice of the instructional designers:

> *In general though on page 2 of the document you sent, you state that the familiar flow of the designer work in a clockwise sequence. This is truly not the case and although you state that designers can enter at any time, the visual graphic alone gives the hint of all of the existing models, start with analysis and then design and so forth. The most recent research and literature however shows that true designers actually identify a problem/identify a solution, then identify the problem clearer/the solution clearer etc. in this constant problem/solution process. This doesn't lend itself to that at all. Maybe if the graphic was changed that would help (lines 10-17)*

Tracey further addressed the issue of adding yet another model to the large existing pool of models. She wrote:

> *I wonder if it is necessary to add another model/framework for designing instruction when there are already so many out there (lines 7-9). The existing models are addressing media selection and this seems like an extremely detailed framework which is nice, but one that I wonder how many designers will actually use (lines 30-32).*

The need and usage of the Framework in various learning environments. In general, experts saw the value and the need for the proposed Framework. They saw a particular value in the integration focus of the Framework. Grant stated:

> *I did particularly like the matrices that focused on STEM integration. I believe this was a real strength of the framework/model. I think there is a need for media or content selection particularly when it comes to interdisciplinary approaches and media or learning objects that have a pedagogical stance (lines 24-27).*

Branch shared similar thoughts on the value of integration:

> *I think the list of questions that are generated to promote integration is helpful for multiple teachers in a single team to generate common content for the students (lines 33-34).*

Branch further added that "... the framework will be used for STEM projects once teachers understand how to use it and are willing to adopt such a framework for content generation" (lines 94-95).

Ability of a novice/expert to work with the framework. In response to the question regarding the ability of a novice and expert designer to work with the model, the experts' opinions were divided. Branch believed a novice designer would require more guidance. He stated:

> *Expert designers should be able to implement the framework with ease. Novice designers may have difficulty implementing the framework (lines 109-110).*

Tracey, somewhat shared the same opinion on the ability of a novice/expert designer to use the Framework. She stated:

> *I am concerned with novices understanding all of the steps and the matrix options along with the theories etc. Experts design with a more intuitive sense and using their design precedents so they would really not need such a model unless it illustrated the problem/solution cycle I briefly mentioned and how all of these components might work in that cycle Lines 102-105).*

Grant, on the other hand, thought that the framework fits more for novice designers. He wrote:

> *The framework makes explicit decision-making for novices. Who those novices are is something you have to decide. Expert designers, I believe, have internalized this process. However, they may not be aware or understand the*

> *assumptions they are taking on when they choose media or content that already exists (lines 98-101).*

Grant further emphasized the need to clarify who the target users are by writing the following:

> *I would recommend you consider specify to whom this framework/model is targeted. Selection is a different "animal" than development. I have observed that instructional designers are developers; teachers and university faculty prefer to be selectors/re-purposers, choosing existing content/media. If teachers and university faculty are the primary audience for this, I would suggest the language and processes be directed to this audience, making connections to these audiences' processes and environments. This may include mentioning teaching processes, assessments, online course development, etc. (lines 83-89).*

Areas of Revision. In addressing areas of revision, Branch recommended that:

> *The directions that are actually presented to the teachers really need to be simplified. Further, examples of other results that use the framework for content selection may need to accompany the information that is shared with the actual practitioner (teachers in the classroom) (lines 35-37).*

Grant questioned the rationale behind the selection of the learning theories and the inclusion of the Theory of Multiple Intelligences:

> *It was unclear to me how and why you chose the learning theory categories OLT, CLT, TSCD, and MIT as you did. There was no rationale as to these. In addition, I am unconvinced that multiple intelligences (theory) is a learning theory, comparable to the others. The research on MI theory has never purported it to be a theory of how people learn (or how to teach for that matter) (lines 46-49).*

Grant further strengthened his point by providing these observations:

> *As I reviewed the matrices, I found the MIT pieces to be weak. I have done quite a bit of work with multiple intelligences, and I would recommend you reconsider these. In Matrix 2, I believe there were overlaps between the MIT and the OLT and CLT sections. For some of the MIT sections, I could not obviously make the connections to multiple intelligences (lines 69-72).*

However, Grant's major concern was the Framework's claim that different events of instruction may require the application of different learning theories:

> *You suggest that for instructional strategy selection, "different learning theories may better work for any given event of instruction." I would encourage you to think more on this. It seems to suggest that we might be able to use different learning-theory-based strategies for different events of an instructional model (lines 52-56).*

Further, Grant makes a point about how teaching and learning beliefs can prevent individuals from "switching" from one theory of learning to another:

> *Some things I would encourage you to consider as you work through this is: Individuals have beliefs about how teaching (instruction) and learning occur. As such, I have found that individuals cannot change (or select strategies) to which they do not believe. In Tom Reeves' speak, instructional designers or teachers cannot change instructional models as they would change clothes. Their beliefs prevent them (lines 56-61).*

Grant also brought into discussion the comparison of learning objects and Legos pieces as one example of incompatibility:

> *In addition, this section reminded me of David Wiley's argument against using Legos as a metaphor for learning objects. Legos can be connected to any other Legos; however, instruction, learning objects, and in your case, instructional*

> *strategies cannot. These learning objectives and strategies and media have pedagogical stances that may be incompatible (lines 61-64).*

Finally, Grant cautioned about the danger of assumptions' confounding when an individual chooses different learning theories for different events of instruction:

> *I do understand that I (and others) may choose to use a cognitivist (or OLT) for some events and then change to discovery learning or inquiry (CLT) for other events and then use assessments that are more objectivist. Questions to consider with this, though, are: Do I recognize the changes in theories and strategies? Do I recognize how I might be confounding the assumptions of one theory to another (lines 65-69).*

Analysis of Data

Qualitative analysis was used for the data collected during expert review. The data were imputed verbatim and labeled per line by expert last name, then summarized first per question, and finally, categorized by the appropriate area in the Framework. The obtained data were incorporated in the revised Framework.

Framework Revision from Experts' Feedback

The changes made for the Framework were in response to the expert recommendation. Below is a description of those changes in relation to the different areas of the Framework.

<u>Amending the framework steps and their sequence:</u> It was decided based on the experts' feedback that the following amendments/changes and modifications will be implemented towards the Framework. First, the Framework will be accompanied by a short introductory note that emphasizes that the proposed Framework is a not an instructional design or

instructional development model. Its purpose to assist in media content selection; therefore it is a media content selection Framework.

This introductory note will also underline the fact that this Framework serves as a guideline to select and repurpose popular media content such as Popular TV shows, movies and video games. This will be done in response to Dr. Tracey's concern that the media options were not analyzed during the Analysis and Design steps.

The author will still keep an oval graphical representation of the framework. However, addressing the comment from Dr. Grant, it was decided to add some visual cues that will help to interpret the sequence of the steps.

Finally, Matrixes # 2and # 3will not be combined but shortened.

General comments and suggestions: In response to Tracey's critique and comments stating that "designers actually identify a problem/identify a solution, then identify the problem clearer/the solution clearer etc. in this constant problem/solution process" (lines 14-16), the author of this study can argue that this exactly what this Framework trying to assist with. Let's assume that in the first cycle of this process, the initial problem is that a practitioner needs to repurpose some type of popular media to introduce or reinforce a science topic. The first cycle solution will be that she/he researches and selects several popular and well-rated sci-fi TV shows.

The second cycle problem will be the need to integrate science and mathematics in her instruction; therefore, Matrix # 1 assists in deciding whether integration is possible and helps to choose the appropriate type of integration.

The third cycle's problem will be the intent to utilize popular media to promote problem-solving in her students (evaluation). The solution would be that Matrices # 2 and # 3 will guide the practitioner to identify the event of instruction, choose a media descriptor and select scenes/ clips from popular media accordingly. Thus, this constant problem/solution process will be accomplished.

In regards to the experts' comments about the complexity for the framework, several changes were implemented. They will be discussed later in this section.

The need and usage of the Framework in various learning environments: Since experts liked the fact that the Framework is focusing on integration and thought that the list of questions in Matrix # 1 promote integration, the author decided to keep this part of the Framework unchanged.

In regards to Tracey's comment that put some doubt on the need of such a framework, the author refers to the literature review on media selection models and the findings from this review which revealed that most, if not, of these models deal with media selection that relates to media attributes not to the selection of specific media content.

Ability of a novice/expert to work with the framework: The experts' opinions on who (novice or expert designers) might use the Framework with ease have been divided; therefore, the overall author's decision was to simplify the Framework in several ways and make it more compact and with lesser steps.

The author agrees with Grant who posits that instructional designers are developers; while teachers and university faculty prefer to be selectors/repurposers who choosing existing media content. The author envisions that teachers and university faculty will be the primary audience for this Framework; therefore the abovementioned changes to the framework have been implemented to make connections to these audiences' processes and environments.

Areas of Revision: Before the expert review was done, the author used the Framework to develop a module on early mathematics topic and selected appropriate media content from various full-length children animated movies that can be used to enrich learning experience for small children during different instructional events. Per Branch recommendation, this example of using the framework can be shared with the future practitioners in order to illustrate the framework in action.

After reading Grant's comments on inclusion of the Theory of Multiple intelligences and seriously contemplating on the topic, the author decided to exclude this theory from Matrix # 2.

In response to Grant's question as to why those particular theories (Objectivist Learning Theory – OLT, Constructivist Learning Theory – CLT, and the Theory of Social – Cultural Development – TSCD) were used in the Framework, it was decided to emphasize more explicitly that this set of theories is just one example of possible theories' choices.

Finally, in response to Grant's concern about possible danger of eclectic approach to instruction and confounding of different theories' assumptions, I would pose the same question as was posed by Graig Rusbult on his webpage (Active-learning theories and teaching strategies, 2013) " In our design of instruction, should our creative thinking be restricted by an assumption that we must use either one method or another? … If several approaches are used … with students who have different learning styles, more students will get at least one teaching style that matches their learning style."

Many research papers criticize extreme teaching methods that use "Pure Discovery" or "Minimal Guidance" (Kirschner, Sweller, & Clark, 2006; Mayer, 2004; Schwartz & Bransford, 1998; Sweller, Kirschner, & Clark, 2007), and promote the use of guided inquiry and direct instruction together, in a way that combines the best features of both to provide the greatest good for the greatest number in education. There is a place for both direct instruction and student-directed inquiry. The challenge is to get the balance between methods and sequence right.

<u>Framework Revision from Expert Feedback</u>

The changes made in graphical representation of the Framework and Matrices were in response to the expert recommendations. The areas that underwent changes are the following:

1. Introduction to the Framework
2. Graph for the Framework
    a) additional arrows that show the steps' sequence were incorporated
    b) Grey-colored Analysis phase, indicating that this step can be skipped if the Framework is used as a supplement to instructional design models.
3. Matrix # 1: It is shortened and media content examples are removed from it. These examples can be provided as extras or Appendices to the Framework.

4. Matrix # 2: The Multiple Intelligences Theory is excluded from the list of theories used as examples.
5. Matrix # 3: It is shortened and media content examples are removed from it. These examples can be provided as extras or Appendices to the Framework.

Revised Framework for media content selection: This Framework was developed with the intent of guiding designers and educators through the process of selection and repurposing of popular media content for instruction. The intended primary audience for this Framework is teachers and university faculty. The suggested media to repurpose are popular films, TV shows and video games. This Framework can be used as a stand-alone tool for instructional design; then all four phases of the Framework should be implemented. However, it is recommended that this Framework is used as a supplement to other widely – used instructional design models; then the Analysis stage can be skipped (grey colored part of the graphical representation of the Framework on page 139), and the practitioner can focus on the media repurposing and media content selection part. The green arrows illustrate the sequence of the steps.

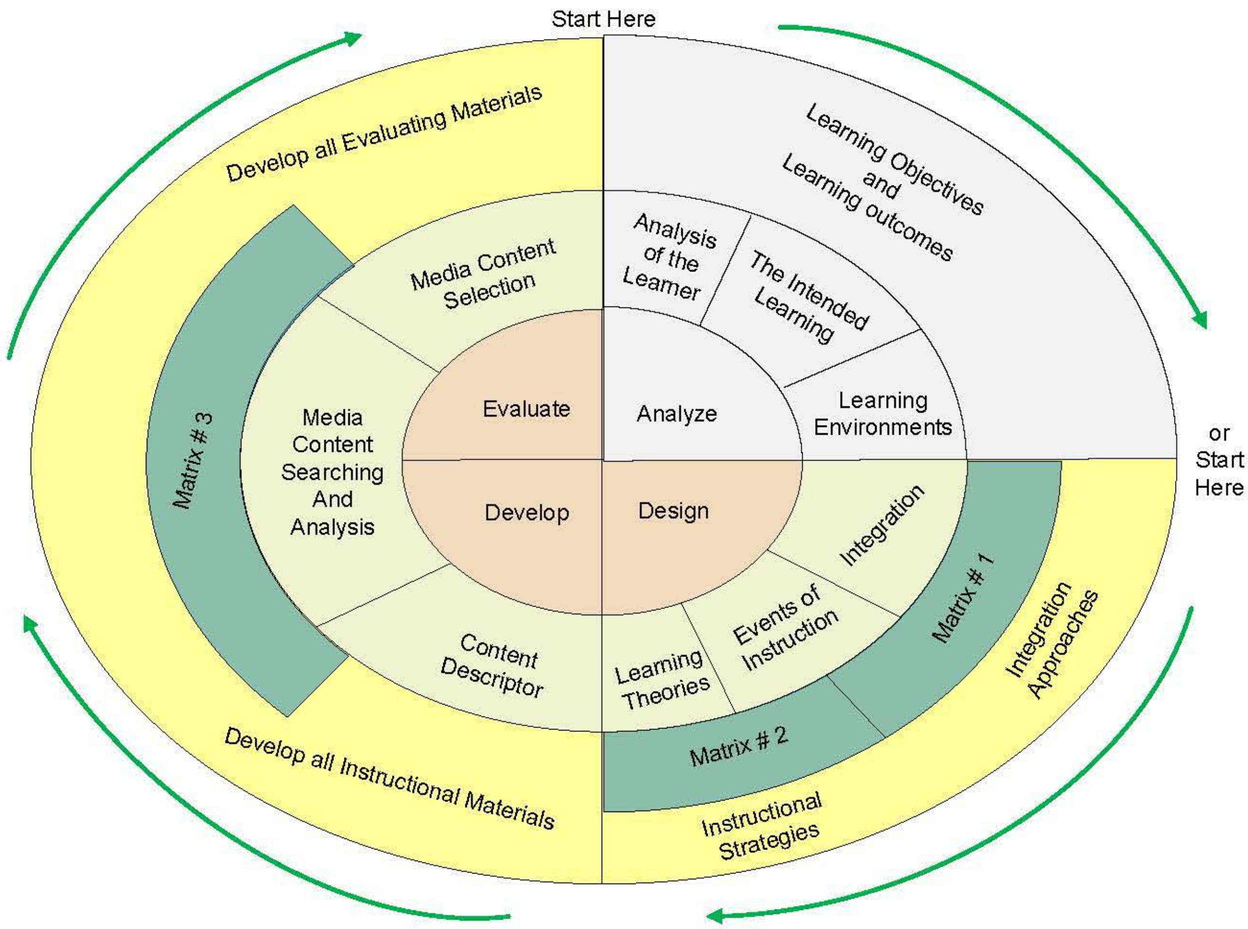

Figure 12: Revised Framework after Expert Review

<u>How to navigate the framework for media content selection</u>

1. The first step "Analysis" includes analyzing the leaner, the intended learning, and learning outcomes. This step is optional and should be done only in case when the Framework is used as a stand-alone tool. This step can be omitted if the framework is used as a complementary to some widely-used existing instructional models and this step is done before media content selection.

Regardless of whether the first step was done before the Framework for media content selection was used or within the Framework, the learning outcomes and learning objectives should be identified before starting the design phase. In addition to the writing of general learning objectives, a separate learning objectives should be identified that address the desired media content. General examples include, but are not limited to the following:

a) After watching the selected media content students should be able to describe what is happening on the screen using the mathematical terms correctly.

b) After watching the selected media content students should be able to apply a learned mathematical concept to the situation on the screen.

c) After watching the selected media content students should be able to use the information provided by the media content to do actual computations and reason whether what happened on the screen could have happened in real-life situations.

2. As you start the Design stage, start with considerations for subject integration.

a) Go to Matrix # 1: **Questions to be considered for Integration.** First, as you go through the matrix, answer the six questions and decide whether you are going to use integration in your instruction. Next, identify the integration approach that you are going to implement. Note, that the listed three integration approaches do not represent the exhaustive list; therefore, fell free to use any other approaches. You might need to return to Matrix # 1 one more time, during the actual media content selection to look for other rich opportunities for integration.

b) The next step will be to choose your instructional strategies. Go to Matrix # 2: **Instructional Strategies.** Identify first the learning domain that you are preparing your instruction for. Next, choose the event of instruction for which you are using the selected media content. Look at the learning theories and corresponding instructional strategies. Note that Matrix # 2 uses three widely excepted learning theories but they are provided only as examples; therefore, practitioners are welcomed to use any learning theory of their choice.

Choose instructional strategies that you will be using of your instruction (or evaluation). Finally, integration should be incorporated into specific instructional strategies for a chosen event of instructions. The result of the Design stage should be selected instructional strategies and approaches to integration.

3. During the Develop/Evaluation stage, the media content must be selected. To start the process got to Matrix # 3: **Media Content Descriptors**. There, each domain of learning is matched with the examples of what media content should illustrate.

4. Start screening the media of your choice (TV show, films, or video games) and pick the scenes where what is going on the screen matches the needed content descriptor. Look for additional opportunities for integration.

5. Finish the media content selection. Note that the selected media content should also correspond to the selected instructional strategies and approaches to integration.

The result of the Develop/Evaluation stage should be selected media clips that can be used for instructional or evaluation purposes.

Table 9

Revised Matrix # 1: Questions to be Considered for Integration

N	**Questions**	**Yes**	**No**
1.	Is connecting/integrating mathematics and science is something that should be pursuit?		
2.	Do you have any personal experiences with connecting mathematics and science?		
3.	Do you have a colleague who can collaborate with you on integrating mathematics and science?		
4	Do you think you have rich content knowledge of your subject matter with respect to connecting one topic/concept to another, or one branch of your subject to another?		
5.	Do you think you have strong pedagogical content knowledge (the ways of representing and formulating the subject it is comprehensible to others (Shulman, 1986, p. 9)?		
6.	Do you think you are able to recognize and build upon various connections between mathematics and science?		

If you have answered positively ***to at least four questions****, you can go forward and choose (or come with your own) approaches to integration. Otherwise, you might want to skip integration and go to the next step of the framework.*

Integrated Approaches

Discipline Specific Integration	**Content Specific Integration**	**Thematic Integration**
This approach to integration involves connecting two topics within one discipline or two branches of mathematics or science. .	This approach involves choosing an existing learning objective from mathematics and one from science. Then an activity is planned that include instruction in each of these objectives. Therefore, infusion of the objectives from each discipline occurs. **Note**: Not all mathematics and science topics can be integrated.	This approach begins with a theme which then becomes a medium with which all the disciplines interact.

Table 10

Revised Matrix # 2: Instructional Strategies
OLT – Objectivist Learning Theories, CLT – Constructivist learning Theories, and TSCD - theory of social cognitive development

Learning Outcomes	Events of Instruction	Learning Theories	Instructional Strategies
Verbal Information	5. Providing learning guidance 6. Eliciting performance 9. Enhancing retention/transfer	OLT	1. Provide and clarify the hierarchical relationships among ideas 2. Use associational techniques (e.g., mnemonics, images, analogies) 3. Use organizational techniques (e.g., clustering, chunking) 4. Use spaced practice 5. Provide cues for effective recall and generalization
		CLT	1. Use novelties, differences 2. Present moderate complexities 3. Use motion, changes, bright images
		TSCD	1. Engage students 2. Motivate students to pursue the instructional goals
Intellectual Skills	4. Presenting the stimulus materials 6. Eliciting performance 7. Providing feedback	OLT	1. Provide examples that clearly embody all the necessary (critical) characteristics of the object, event, or phenomena 2. Have the learner examine the non-examples as well
Discrimination		CLT	1. Present information in a variety of ways to encourage learners to view the knowledge base from multiple viewpoints 2. To improve retention- sequence screens and present related materials
		TSCD	1. Engage and motivate students to pursue the instructional goals 2. Provide opportunities for reciprocal teaching
Concepts	4. Presenting the stimulus materials 6. Eliciting performance 7. Providing feedback	OLT	1. Present clear examples and Guide learners to discover the underlying concepts 2. Present matched non-examples and Guide learners to discover the non-relevant attributes of the concepts 3. Encourage learners to think of their own examples of the concepts 4. Use analogies 5. Provide new information by changing cognitive component
		CLT	1. Revision from different conceptual perspectives 2. Use multimedia to provide visual context
		TSCD	1. Provide opportunities for scaffolding 2. Provide opportunities for reciprocal teaching

			3. Access the zone of proximal development
Rules/Principles		OLT	1. Guide learners in reviewing the concepts underlying the principles procedure 2. Present learners with the statement of the principle/procedures 3. provide subsequent examples of the principle's application 4. Guide learners to identify the features of a situation that suggest a particular principle/rule/should be used
		CLT	1. Revisiting context at different times 2. Actively using what is learned 3. Allow student to assume practitioners and professional roles and act out situations that they find in real world 4. Students research the topic and can present findings to the class
		TSCD	1. Provide opportunities for scaffolding 2. Provide opportunities for reciprocal teaching 3. Create a dialog between students and a teacher beyond answering questions and engage in the discourse
Problem Solving		OLT	1. Provide problems not previously encountered 2. Discompose the problems into sub-problems
		CLT	1. Provide authentic real world problems 2. Support problems with visual images to help learners construct mental images and visualize activity 3. Present alternative ways of representing problems 4. present new problems and situations that different from the conditions of the initial instruction
		TSCD	1. Students and a teacher play untraditional roles as they collaborate with each other 2. The physical classroom provides a setting for peer instruction, collaboration, and small group instruction 3. Classroom becomes a community of learning
Cognitive Strategies		OLT	1. Frequently present learners with novel and challenging problems
		CLT	1.Instruction must be concerned with the experiences and contexts that make the student willing and able to learn 2. Instruction should be designed to facilitate extrapolation and or fill in the gaps

Table 11

Revised Matrix # 3: Media Content Descriptors

Domains of Learning	**What the selected media should do/depict/illustrate…**
Facts and Information/ Verbal/Discrimination	1. Illustrate the facts 2. Provide simple information
Concepts and Ideas/Concepts, Rules and Principles	1. A movie clip, a scene from a video game, or a TV show clip illustrates the physics principle or the mathematics concept. Those scenes and clips also allow analyze them against the background of the fundamental science and mathematics laws and rules. The impact of the media content is being able to understand why, in reality, the scene could or could not have occurred as depicted in the film, video game, or TV show, what the director got right and what he got wrong,
Intellectual: How to/ Problem Solving and Cognitive Strategies	1. Media content provide enough information to pose a problem that learners need to solve 2. Media content make use of science and mathematics laws and principles that are embedded into plots and actions. Learners have an opportunity to use the information provided by the media content to do actual computations and reason whether what happened on the screen could have happened in real life.

Chapter 6: Discussion and Recommendations

The purpose of this study was to construct and validate a framework for media content selection that can be used as a stand-alone tool, or can be incorporated as a part of the widely-used instructional design models. This study was design and development research in nature and incorporated five separate research parts.

1. Part One consisted of the literature review, which, in turn, had four sections.
    a) The first section was a literature review to identify instructional design models and analyze their similarities and differences. Special attention was given to media selection models.
    b) The second section of the literature review focused on the repurposing of popular media and investigated how the results of the current research have impacted the practice of utilizing of popular media for educational purposes.
    c) The third section of the literature review concentrated on learning theories and their use in instructional design process.
    d) Finally, the last section of the literature review focused on the research related to integration or multidisciplinary links and identified various types of integration as well as rationale for using integration while developing instruction.
2. Part Two consisted of the research methodology of the study and the findings from the literature review's four sections. These results were then used to develop the Framework for media content selection.

3. Part three consisted of the development of the first iteration of the Framework for media content selection.
4. Part Four consisted of the module development related to early mathematics. The first iteration of the Framework was used for this purpose. The results of this process were used to develop the second iteration of the Framework.
5. Part Five consisted of the expert review evaluating the Framework for media content selection. Data received from experts were analyzed and the results were used to make the Framework revisions.

The resulting framework provides instructional designers, teachers, and college professors a way of creating learning environments that enrich learning experiences for their students. The findings of this study have implications on the areas that pertain to instructional design, content integration, repurposing of popular media, and media selection for instructional use.

The Framework for Media Content Selection

This study started with the overview of the existing instructional design models. The models reviewed possess many of the core elements (Analyze, Design, Develop, Implement, and Evaluate) identified by Gustafson (2000), each embedded in a different way in the models' steps.

Six of these models were reviewed in more detail. Each of these models has its own value and possesses different levels of emphasis on various design activities. Morrison, Ross, and Kemp model manifests the cyclical process of instructional design, and Dick & Carey model puts a lot of focus on conducting instructional analysis, while ASSURE model incorporates technology to enhance instruction.

A number of media selection models were reviewed for this study. The results of the literature review revealed that the existing media selection models can help users to progress only so far and can assist a designer in choosing appropriate media (movies, TV show, video games, or computer simulations) only partially. Some of the models focus on media attributes, such as ability to present symbols, produce sound, or depict motion. Other models focus more on learners' characteristics, the instructional settings, and the learning tasks. But most of these models are helpless in providing guidance as to how select media "within media": how one should choose the TV shows clips to introduce a certain topic for early mathematics learners? What sequence of the scenes from sci-fi movies to select and present to reinforce high school mathematics or science concepts? How one should select an appropriate level of a video game to assess knowledge about ancient civilization? All these media selection models, as indicated by Sugrue and Clark (2000), left the question about how media is actually selected by practitioners in the real world unanswered.

It became obvious after the literature review that most instructional design models do not take a multidisciplinary approach; thus, often omitting the most effective and innovative options for new creative learning environments. Research has shown that integrated curriculum attempts should not be seen as an interesting diversion but as a more effective means of presenting the curriculum, regardless what school subject is being taught. Thus, the curriculum becomes more relevant when there are connections between subjects rather than strict isolation. The finding from integration section of the literature review encouraged the author to incorporate integration in the Framework for media content selection. The subject matter experts saw this feature of the Framework for media content selection as one of its major strengths.

After the first iteration of the Framework for media content selection was built, it was used to develop an instructional module on early mathematics topic. This module incorporated the repurposing of full-length animated films. All steps of this process were recorded, analyzed and later used to modify and revise the Framework. The result of this research component was the second iteration of the Framework.

In the final part of this study, the second iteration of the Framework was validated using the strategies such as an expert review by a team of three subject matter experts. The final changes made for the Framework for media content selection were in response to the expert recommendations.

Recommendations for practitioners

The Framework for media content selection appears to be a tool a designer can use when repurposing popular media for instructional purposes, thus creating instructional materials that enrich and improve instruction. This study suggests a number of practical guidelines for effective use of the framework. The following list is some recommendations for instructional designers and other practitioners who might choose to use the Framework for media content selection.

1. It is important to decide from the very beginning whether the Framework will be used as a stand-alone tool or as a supplement to other instructional models. If the latter is true, the Analysis step can be skipped, and the designer can concentrate on the other three phases. Use the Framework in conjunction with the instructional design model you are most comfortable with.

2. It is helpful to choose the type of popular media (film, TV shows, or video games) to be repurposed at the early stage of the design process. As advised by Dr. Tracey, during the analysis step it is important to include analyzing the media options and decide on what is available for a designer to use in a specific learning context.
3. Follow all the steps identified by the Framework. Begin with the decision on integration options. The Framework provides a way for designers to focus on what integration strategies work best for their target audience. As explained by Berlin & Lee (2005) integration efforts may lead to enriched classroom experiences, promote student engagement in learning, and improve student attitude toward and achievement in both science and mathematics.
4. Select instructional events for which you wish to develop instructional materials and use Matrix # 2 as a guide. Incorporate only those learning theories that support your own beliefs how teaching (instruction) and learning occur. If you plan to use different learning theories for various events of instruction, follow Dr. Grant's advice that he provided in his exert review and consider the following questions: Do I recognize the changes in theories and strategies? Do I recognize how I might be confounding the assumptions of one theory to another?
5. Follow all the procedures in the selecting popular media according to content descriptor step using Matrix # 3 as a guide.

Concluding Thoughts

This study was limited to one validation situation, which was expert review. The findings and results of this study point to many areas in which future research is needed. Both novice and expert designers should test the Framework for media content selection to determine its strengths and limitations. In addition, the Framework should be tested as a stand-alone model and in conjunction with other instructional design models in a variety of settings.

Studies should be done that involve learners and learners' motivation, performance, and attitudes toward STEM subjects during and after interventions should be studied. Those instructional interventions should contain instructional materials (repurposed popular media) developed using the Framework.

Practitioners and researchers constructing media selection models in the future may wish to begin by choosing the focus of their model. The focus could be on media attributes or learners' characteristics and the learning tasks. Or, the focus could be on media content itself.
However, this does not preclude the possibility of models that reflects both areas of emphasis.

Instructional Design and Technology is an interesting and eclectic discipline, as noted by Michael Spector (2004). He observed that we have more instructional design models than there are elements in the periodic chart. He continues and writes that, just as there are groups of elements (nine by some accounts), the various instructional design models can be grouped – by context or setting (see Branch & Gustafson, 2002) or by many other differentiating factors such as underlying learning theory, delivery mode, and so on.

But the sheer number of instructional design models does not preclude professionals in the field from creating new models. This continuing process is empowered by a rapid evolution of new teaching and learning modes and allows instructional design to keep up with technological and institutional changes. David Jonassen et al. (2007) argued that "Like the chiropractor who realigns your spine, we might become healthier from a realignment of our theories. If we admit and attempt to accommodate, some of the uncertainty, indeterminism, and unpredictability that pervade our complex world, we will develop stronger theories and practices that will have more powerful (if not predictable) effects on human learning" (page 33).

Hopefully, the Framework for media content selection and this study will help instructional designers and other practitioners focus on repurposing popular media, thus, creating engaging and creative instruction that motivates their learners and leads to deeper knowledge acquisition.

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APPENDICES

Appendix A

A CHECKLIST FOR ADDRESSING COMMON CONCERNS OF PRODUCT RESEARCH DESIGN

(Richey & Klein, 2007, p. 64)

1. Determine if the study will be conducted while design and development activities are occurring or if retrospective data will be used.

2. Use formative, summative, and/or confirmative evaluation to address questions of product and tool impact such as the following:
   - Is the product or tool usable and practical?
   - Is it cost effective and does it provide an appropriate return on investment?
   - Does it impact attitudes, learning, performance, and organizational results?

3. Identify techniques that provide for objective data collection, especially if you are serving as both designer/developer and researcher.

4. Establish validity of data and the subsequent findings so that the following questions can be addressed:
   - Are the data supported by multiple sources?
   - Have all biases been avoided?
   - Have in progress data been collected?
   - Have design and development procedures and instruments been piloted?

5. Facilitate generalizability so that the following questions can be addressed:
   - Are the findings sustained over time?
   - Are the findings sustained across settings?
   - Are the findings sustained with varying designers/developer?
   - Can the findings be interpreted broadly?

6. Anticipate and control potential problems by addressing the following questions:
   - Have any technical barriers of product evaluation or use been removed?
   - Have unique designer/learner characteristics been accommodated?
   - Have constraints imposed by natural work environment been accommodated?

Appendix B

PHASE I MODULE DEVELOPMENT DAILY LOGS

Table 12

Analysis Stage Daily Log

Date/Time	Activity	Resources	Results/Reasoning	Lessons Learned
4/24/2013 9:42 am	Identifying learners' characteristics	Piaget Researcher's personal teaching experience	Some of the group characteristics the learners share are the following: 1) they are the same age; 2) they prefer to learn through play or other engaging activities; 5) they are at the pre-operational stage of their cognitive development. At the same time, the group of my learners is a diverse group of learners who come from families with different socio-economic status and they also have different learning styles. At this age, young children are naturally curious, and appear driven by a need to explore and interact with their world. Their intrinsic motivation to learn is very high.	If a designer/instructor knows his/her learners well, this step can be omitted. Also, if the framework is used as a complimentary to existing design models, this step can also be skipped.
4/24/2013 10:00 am	Deciding on the content to be learned	Early mathematics standards, both national and local. The current mathematics curriculum.	Students should learn a concept of "in-front-behind" from the early mathematics topic on spatial relationships. They already know other spatial relationships such as "left-right", "near – far", "short-long", and others.	
4/24/2013 10:10 am	Identifying learning environments	Researchers' personal experience	The learning will take place at the elementary public school that has all the equipment and resources available for productive and successful learning. Teachers know their subject matter well and they are experts in urban education. Classrooms are clean, spacious, and have all necessary materials and resources including books, paper, office materials, etc. The expected number of learners is 20	Learning can also be informal and can take place at summer camps, after-school programs, and other informal environments.

			pre-K students. The classroom where the learning will take place is a spacious room with a lot of natural light coming from the big windows. The desks are very comfortable and have enough space between them. The walls of the classroom are decorated with educational posters, children's pictures and with other appropriate items. The whole environment is very welcoming and friendly.	
4/24/2013 10: 30 am	Writing learning objectives		At the end of the lesson students will be able to: 1. Distinguish between "in-front-behind" position in space and be able to place appropriate objects in- front or behind other objects using tools such as pre-made drawings, pre-cut shapes, crayons, and glue. 2. Use mathematical terms "in-front-behind" correctly 3. Watch selected media clips and apply the mathematics concept of "in-front – behind' to the situations on the screen.	It is helpful to write the learning objectives in relation to the media content as well. In this respect, the media content becomes another "tool" that students would use to illustrate their competency with a concept.
4/24/2013 10:45 am	Identifying desired learning outcomes		The desired outcome fits into "Intellectual Skills" learning domain because the learner must perform some unique cognitive activities. In my case, the learner must be able to perform an activity with previously un-encountered examples. Since the learner needs to learn to identify a stimulus as a member of a class having some characteristics in common (e.g. all toys are in-front of the book, all toys are behind the book), the learning subcategory is "Concrete Concepts'.	

Table 13

Design Stage Daily Log

Date/Time	Activity	Resources	Results/Reasoning	Lessons Learned
4/24/2013 11:00 am	Deciding whether to include integration or not	Researcher's personal teaching experience	The researcher answered positively to five questions out of six in Matrix # 1. She answered negatively to the questions about the colleague who she could collaborate with on integration. Since the researcher assumed the role of an elementary teacher who usually teachers all subjects, the collaboration with another teacher is not essential.	
4/24/2013 11:10 am	Deciding on the type of integration		The unit topic of interest was the spatial relationships and the researcher chose the discipline-specific integration where she would be able to integrate the current topic of the lesson (in-front – behind) with other spatial topics.	A complete solution for integration options cannot be accomplished during the Design stage. Until the media content is selected, it is almost impossible to judge what other rich opportunities for integration exist. Therefore, a designer needs to come back to integration decision one more time after the media content has been selected.
4/24/2013 11:20 am	Selecting the events of instruction that the media content will be used for.	(Gagne et al., 1992), researcher's personal teaching experience	4. Present the material to be learned 6. Elicit performance "practice": let the learner do something with the newly acquired behavior, practice skills or apply knowledge. 9. Enhance retention and transfer:	
4/24/2013 11:30 am	Identifying learning theories	Research literature Researcher's personal experience		Different learning theories may better work for any given event of instruction; therefore, a learning theory (s) and corresponding instructional strategies must be chosen for each event of

				instruction.
4/24/2013 11:40 am	Selecting instructional strategies	Research literature Researcher's' personal experience		Specific and more detailed instructional strategies must be selected for each event of instruction.

Table 14:

Development and Evaluation Stages Daily Log

Date/Time	Activity	Resources	Results/Reasoning	Lessons Learned
4/24/2013 9:42 am	Finalizing learning domains	Results of analysis and design stages, researcher's own teaching experience.	During the earlier stages of the module development, it was finalized that the domain of learning was "Concepts". But the selected strategies suggest that we may also want to consider the learning domain "Intellectual - problem solving" since one of the chosen strategies provides for posing a problem for the students.	Sometimes, the chosen instructional strategies dictate what learning domains should be used in instruction.
4/24/2013 8:00 pm	Identifying content descriptors and describing what each selected media content should do/depict/illustrate in relation to the mathematics concept "in-front-behind".	Chosen events of instruction, Matrix # 3 on media content descriptors.	Five scenes from animated movies were selected to accommodate the chosen strategies for three events of instruction.	This step requires additional attention since it influences how well the selected media content will match the desired learning outcomes.
4/25/2013 6:00pm	Deciding on what animated children's movies to be screened.	Internet, researcher's personal experience	Using purposive sampling, movies were selected that are most commonly watched by children. From this group, additional selection criteria were used including movies released in theaters for the first time after 1990 and movies rated in the top 10 animated films or top 25 movies. The movies selected represent those with either sustained or current popularity.	
4/26/2013 -4/30/2013 2 hours each day.	Screening and analyzing the animated children's movies		The movies were watched, and information was recorded that was relevant to each required content descriptor: times frames, the content included, and character descriptions.	This was the most time-consuming part of the module development. Also, this process requires a lot of attention.
05/12/2013	Selecting scenes that match media content descriptors identified	Selected animated children's movies, results of the	Five scenes were selected.	The selection of media content brought about other unexpected opportunities for

	earlier.	previous steps of this stage.		integration. For example, the scene # 4 from Shrek contains a lot of characters from various fairy tales; therefore, it becomes natural to incorporate a discussion about what fairy tales they are coming from, their names, character traits, etc. Thus, this media content presents a natural way to integrate Language Arts into mathematics lesson, and hereby, enrich students learning.

Appendix C

EXPERT FEEDBACK

Q1: What are your general comments and suggestions about the framework?

Grant: In general, I could see where you were trying to get to with this framework. I became confused early on as to whether you were discussing instructional design models, instructional models, instructional development models, etc. I also was confused by the different language of "framework" and "models" and if these were different (to you). I think this should be clarified early on in the description of the research problem.

Tracey: I understand what you are attempting to do and commend you in doing so but I wonder if it is necessary to add another model/framework for designing instruction when there are already so many out there. If you decide to do so however I do have a few general comments and specific suggestions I provide in the following questions. In general though on page 2 of the document you sent, you state that the familiar flow of the designer work in a clockwise sequence. This is truly not the case and although you state that designers can enter at any time, the visual graphic alone gives the hint of all of the existing models, start with analysis and then design and so forth. The most recent research and literature however shows that true designers actually identify a problem/identify a solution, then identify the problem clearer/the solution clearer etc. in this constant problem/solution process. This doesn't lend itself to that at all. Maybe if the graphic was changed that would help.

Branch: My initial impression is that the idea is appropriate for our field and such a framework is important for instructional designers and media developers. However, the initial reaction of a practitioner or teacher of math science for that matter, would likely find this extremely complex and thus, not even attempt to use.

Q2: What are your general thoughts about the need of such framework for media content selection?

Grant: I did particularly like the matrices that focused on STEM integration. I believe this was a real strength of the framework/model. I think there is a need for media or content selection particularly when it comes to interdisciplinary approaches and media or learning objects that have a pedagogical stance. In addition, I would recommend that you consider how the media selection and strategy selection stages/phases from Smaldino's ASSURE model relates to what you're doing here.

Tracey: I do question if there is a need. The existing models are addressing media selection and this seems like an extremely detailed framework which is nice, but one that I wonder how many designers will actually use.

Branch: I think the list of questions that are generated to promote integration are helpful for multiple teachers in a single team to generate common content for the students. However, the directions that are actually presented to the teachers really need to be simplified. Further, examples of other results that use the framework for content selection may need to accompany the information that is shared with the actual practitioner (teachers in the classroom).

Q3: **What are your general comments about the framework's steps and their sequence?**

Grant: Here are some thoughts I had: First, sequences are rarely depicted in circles/oval, because these visually communicate relationships or parts of a whole. If there is a specific sequence, then visual cues should be added in order to interpret the sequence. As I read through the description of the research problem and then into the introduction for "The Framework," I was confused as to whether this was an instructional design model or media selection or instructional development model. This was reinforced when reading through the analysis and design phases of the framework. It was unclear to me how and why you chose the learning theory categories OLT, CLT, TSCD, and MIT as you did. There was no rationale as to these. In addition, I am unconvinced that multiple intelligences is a learning theory, comparable to the others. The research on MI theory has never purported it to be a theory of how people learn (or how to teach for that matter). On page 7, you noted that this step can be omitted if used as complementary to an ID model. I thought this helped me to understand more of what you were trying to "get to." So, I would recommend that you somehow integrated this kind of language and depict/explicate how this media selection framework relates to ID models earlier. On page 8, you suggest that for instructional strategy selection, "different learning theories may better work for any given event of instruction." I would encourage you to think more on this. It seems to suggest that we might be able to use different learning-theory-based strategies for different events of an instructional model. I'm not sure if this is what you meant or not. Some things I would encourage you to consider as you work through this is: (1) Individuals have beliefs about how teaching (instruction) and learning occur. As such, I have found that individuals cannot change (or select strategies) to which they do not believe. In Tom Reeves' speak, instructional designers or teachers cannot change instructional models as they would change clothes. Their beliefs prevent them. In addition, this section reminded me of David Wiley's argument against using Legos as a metaphor for learning objects. Legos can be connected to any other Legos; however, instruction, learning objects, and in your case, instructional strategies cannot. These learning objectives and strategies and media have pedagogical stances that may be incompatible. So that I do not sound too harsh here, I do understand that I (and others) may choose to use a cognitivist (or OLT) for some events and then change to discovery learning or inquiry

(CLT) for other events and then use assessments that are more objectivist. Questions to consider with this, though, are: Do I recognize the changes in theories and strategies? Do I recognize how I might be confounding the assumptions of one theory to another? As I reviewed the matrices, I found the MIT pieces to be weak. I have done quite a bit of work with multiple intelligences, and I would recommend you reconsider these. In Matrix 2, I believe there were overlaps between the MIT and the OLT and CLT sections. For some of the MIT sections, I could not obviously make the connections to multiple intelligences.

Tracey: During the analysis step, I think it is important to include analyzing the media options. In other words, what is available for you to use in the learning context? If you don't know this up front, the rest of the framework doesn't matter. The media in this framework isn't addressed in the design phase which is a problem. I do like the idea of integration approaches considered prior to instructional strategies. Matrix 2 is not specific enough, and the more I look at it the more I wonder if Matrix 2 and 3 could be combined. I don't know, but it is something to consider.

Branch: I think the steps in sequence are appropriate. I did, at first, wonder why implementation was omitted while analysis, design, development and implementation were included.

Q4: **What is your general opinion on the usage of the framework for various projects and environments?**

Grant: I would recommend you consider specify to whom this framework/model is targeted. Selection is a different "animal" than development. I have observed that instructional designers are developers; teachers and university faculty prefer to be selectors/repurposers, choosing existing content/media. If teachers and university faculty are the primary audience for this, I would suggest the language and processes be directed to this audience, making connections to these audiences' processes and environments. This may include mentioning teaching processes, assessments, online course development, etc.

Tracey: I have designed for over 25 years in numerous design situations and have never had the time to use something with so many steps and so many questions etc. to consider. If I were to use this, I would need the analysis step to be considerably developed because so many decisions are made during that phase.

Branch: I think the framework will be used for STEM projects once teachers understand how to use it and are willing to adopt such a framework for content generation.

Q5: **What are your general thoughts about implementation of the framework by both novice**

and expert designers?

Grant: The framework makes explicit decision-making for novices. Who those novices are is something you have to decide. Expert designers, I believe, have internalized this process. However, they may not be aware or understand the assumptions they are taking on when they choose media or content that already exists.

Tracey: I am concerned with novices understanding all of the steps and the matrix options along with the theories etc. Experts design with a more intuitive sense and using their design precedents so they would really not need such a model unless it illustrated the problem/solution cycle I briefly mentioned and how all of these components might work in that cycle. I do wonder however if as illustrated, this is another version of what we have seen and teach over and over again. If you consider redoing the framework within a more holistic real picture of design, it might be useful for both novice and expert designers.

Branch: Expert designers should be able to implement the framework with disease. Novice designers may have difficulty implementing the framework.