Exploring Teaching Practices of the Agricultural Education at Bangladesh Agricultural University (BAU)

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ABSTRACT

The purpose of this study was to understand the teaching practices of the Agriculture Faculty at Bangladesh Agricultural University (BAU). This study is at the intersection of the critical assessment & examination of assumption and exploring options and plans stages of transformative learning theory (Mezirow, 2000) and the environment factor of Astin's I-E-O model. Previous studies showed that tertiary education of Bangladesh fails to develop critical thinking abilities among the students. Higher order teaching practices help to develop critical thinking abilities among the students. Thus, it is important to explore the level of teaching practices at the Agriculture Faculty of BAU to understand how it supports critical thinking abilities among the students. Graduates being able to use critical thinking skills to solve agricultural issues will increase total food production and reduce national poverty. This study was an instrumental single case study. Faculty of Agriculture of BAU was the unit of analysis for this study. The findings of this study were only generalizable to the Agriculture Faculty at BAU and only relevant for Summer 2020. The phenomenon of this study was teaching practices at the Agriculture Faculty of BAU. Data sources included a census survey of active faculty members and content analysis of course syllabi. Findings from this study suggested that both teaching methods and course learning outcomes of the courses of the Agriculture Faculty at BAU were related the lower order of Revised Bloom's Taxonomy (RevBT). Moreover, faculty members from biological science and engineering used more teaching practices from evaluating level of RevBT than social science disciplines. Evaluating level is considered as higher level of RevBT. Male faculty members also used more teaching practices related to analyzing level than female faculty members. Analyzing level is also considered as higher level of RevBT. Faculty members identified that they have lack of training, standard teaching resources to use higher order teaching practices. Moreover, they also said that students of the Agriculture Faculty at BAU are more interested in job preparation than classroom education. However, faculty members also felt that higher order teaching practices can improve the creativity and critical thinking abilities for students and brings enthusiasms in teaching. Faculty members recommended that BAU revise its curriculum, syllabi, and assessment strategies to create higher order teaching practices in classrooms. As a result of this study, there is opportunity for faculty to increase their use of higher order teaching practices and develop course outcomes that support higher order learning. In addition, the university should revise their existing curricula and assessment techniques and give more freedom to the faculty members to choose their teaching and assessment methods. Finally, training should be organized to support higher order teaching by female faculty members.

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GENERAL AUDIENCE ABSTRACT

The purpose of this case study was to understand the teaching practices of the Agriculture Faculty at Bangladesh Agricultural University (BAU). Conceptually, this study was coupled up with transformative learning theory (Mezirow, 2000) and the Astin's I-E-O model. The unit of analysis of this study was the educational environment provided by Agriculture faculty of BAU that offers a single under-graduate degree program called B.Sc. Ag. (Hons.). A structured survey questionnaire was used to collect data from the faculty members of the Agriculture Faculty of BAU based on Revised Bloom's Taxonomy (RevBT). Additionally, all course syllabi were analyzed to identify the level of intended teaching practices based on RevBT. RevBT is the benchmark standard to evaluate the cognitive orders of the teaching-learning process, curriculum planning, instruction, and test tasks. Findings from this study suggested that faculty members slightly more preferred teaching practices from the lower levels of RevBT for the classroom teaching at BAU. Findings also suggested that teaching practices connected to the higher cognitive levels of RevBT were significantly varied based on academic disciplines and gender of the faculty members. Faculty members mentioned that lack of students' interest in classroom lessons, the rigid curricula and existing examination system of BAU, large numbers of students in classes, and lack of training of the faculty members are the main limiting factors for them to use higher order teaching practices in classrooms. However, faculty members also wanted to use the higher order teaching practices in classrooms as higher order teaching practices enhances students' creativity, problem solving skills, and critical thinking skills. Faculty members suggested to update course curricula, syllabi, and the exam system to support higher-order teaching practices at BAU. Findings from the course syllabi analysis supported that most of the action verbs of course learning outcomes of the course syllabi were connected to the lower cognitive levels of RevBT. As a result of this study, there is opportunity for faculty to increase their use of higher order teaching practices and develop courses that support higher order learning. In addition, the university should revise their existing curricula and assessment techniques and give more freedom to the faculty members to choose their teaching and assessment methods. Finally, training should be organized to support higher order teaching by female faculty members.

DEDICATION

To my Inspiration………

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I have started my PhD journey at the Department of Agricultural, Leadership, and Community Education with a lot of hopes and aspirations in January 2018. My entire PhD duration was five and half semesters long. My PhD journey was like a roller-coaster ride that gave me a bunch of excitement and pleasant learning experiences. Thus, I would like to thank all the people, without whom this journey would not have been possible.

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TABLE OF CONTENTS

List of Figures

List of Tables

Chapter 1 - Introduction

Bangladesh Agricultural University (BAU) is the oldest agricultural university that provides higher education in Bangladesh. BAU was established in 1961 in the Mymensingh district of Bangladesh. At the time of its establishment, BAU had an active collaboration with Texas A&M University for developing the course curricula and syllabi, faculty exchange programs, and infrastructure development. BAU has six faculties (i.e., colleges equivalent to USA university system), 44 departments, and four institutes. Currently, 567 faculty members are serving at BAU with 5,147 undergraduate students and 2,941 post-graduate students. BAU has its own extension system referred to as the Bangladesh Agricultural University Extension Center (BAUEC). The purpose of this center is to develop and disseminate technology and knowledge developed at BAU to the adjacent farming communities of BAU (Bangladesh Agricultural University, n.d.). BAUEC works in collaboration with the governmental, Department of Agricultural Extension, which is the largest extension organization of Bangladesh. Department of Agricultural Extension is one of the major employers for the graduates of the Agriculture Faculty at BAU.

The Faculty of Agriculture is the largest faculty of BAU. It has sixteen departments. This faculty has produced 12,989 graduates, 8,049 Masters graduates, and 296 PhDs (Faculty of Agriculture, n.d.). In total, twenty departments from four faculties offer 115 courses to fulfil the requirement of the B.Sc. Ag. (Hons.) undergraduate degree.

Need for Current Research

The curricula for the higher educational institutes of Bangladesh are teacher-centered and follow outdated teaching and learning processes that create less opportunity for the development of higher-order cognitive skills among the students (Rahman et al., 2019). Mahmud et al. (2018) reported that university graduates of Bangladesh lack higher-order cognitive and soft skills, which are required for better job placement. There are also limited numbers of peer-reviewed research, reports, and scientific articles related to the quality of higher education in Bangladesh (Rahman et al., 2019). Moreover, the learning assessment techniques of the higher educational institutes of Bangladesh fail to assess higher-order learning for the students. At the Agriculture Faculty at BAU, out of 100% total marks for an examination, 10% marks are reserved for class attendance, 20% marks are reserved for in-class tests, and 70% marks are reserved for the closed-book final exam. Kuri et al. (2019) found that 89% of the closed-book final exam questions for the theory courses of all academic years of the Agriculture Faculty of BAU from 2002 to 2016 assessed only the lower-level learning outcomes of the students as defined by Revised Bloom's Taxonomy (RevBT).

This research will contribute to greater understanding related to levels of learning that are supported through teaching practices and course syllabi of the Agriculture Faculty at BAU. The proposed research also contributes to the literature on higher education related to agriculture in the context of Bangladesh. The proposed research also contributes to the literature of teaching-learning approaches in agricultural education in the context of an international, developing country.

Audiences that will Benefit

The findings of this study will be shared with faculty members, departmental heads, the dean, and the Vice-chancellor of BAU. Faculty members can use this information to review their classroom instructional pattern based on the results of the study. Moreover, the faculty members may also revise their choice of pedagogical approaches to support the development of critical thinking in students. Departmental heads and dean may also use the findings to raise awareness among the faculty members during departmental meetings and Board of Study meetings on positive teaching behavior and encourage the faculty members to perform higher-order classroom teaching practices.

The dean and the Vice-Chancellor may arrange need-based training programs for different elements of the classroom process (i.e., planning, management, and instruction) to improve the teaching process of faculty members. The university authority (e.g., Institutional Quality Assurance Cell at BAU) may initiate teaching evaluation for the current faculty members to bring accountability in the present teaching process. Government, national, and international donors may use findings from this study to improve the higher agricultural education in Bangladesh and other developing countries.

Purpose of this Study

The purpose of this study was to understand the teaching practices of the Agriculture Faculty at BAU. This study helped me to determine the level of teaching practices of the Agriculture Faculty at BAU based on different cognitive levels of RevBT. This study also assisted me to conceptualize the factors, which discourage and encourage faculty members to use of higher-order teaching practices in their classrooms. Additionally, through this project, recommendations were identified to create higher-order teaching practices BAU classroom teaching provided by the faculty members of the Agriculture Faculty at BAU.

Research Questions

To achieve the goal of the proposed study, the overarching research question was "What level of teaching is supported by the Agriculture Faculty of BAU as related to the cognitive levels of RevBT (Anderson et al., 2001)?" The underlying research questions for this study are as follows:

1. What is the supported cognitive level of teaching practice of the Agriculture Faculty at BAU based on RevBT (Anderson et al., 2001)?
2. Does the supported cognitive level of teaching practice at BAU vary based on academic discipline, professional rank, or gender of the faculty members of the Faculty of Agriculture?
3. What discourages or encourages Agriculture Faculty at BAU from using teaching practices that support higher order cognitive levels based on RevBT (Anderson et al., 2001)?
4. What are the recommendations of the Agricultural Faculty members at BAU to create higher-order teaching practices?

Conceptual Framework of the Study

This study is at the intersection of the stage 2 and stage 3 of transformative learning theory and the environment factor of Astin's I-E-O model. All specific research questions were laced with the stage 2 and stage 3 of transformative learning theory. The critical assessment of the teaching and curriculum explored the level of teaching practices and tested the assumptions of variation of teaching practices based on disciplines, professional ranks, and gender of faculty members. Identifying the factors, which discourage and encourage the faculty members will help to understand the quality of teaching more elaborately. Exploring the suggestions and plans made by the faculty members to create the higher order teaching in classrooms ultimately creates options and plans towards desired changes in teaching quality. Finally, by utilizing the findings of this study, the practitioners of BAU may formulate and implement the most appropriate plans to improve the educational quality in Bangladesh. Therefore, the quality education can accelerate the overall societal development and reduce the hunger, poverty, and homelessness.

Teaching quality can be assessed by using LOTSHOTS tool (Wang & Farmer, 2008). Moreover, open ended questions will help the faculty members to explore the plans and options to improve the teaching quality. Teaching quality and curricular quality are two important elements of the environment factor of Astin's I-E-O model. Thus, quality teaching and curriculum contribute to better college environment. Therefore, it is required to assess the quality of the teaching practices and curriculum of BAU to understand how extent it supports standard teaching environment. The findings of this study will help the practitioners to take necessary steps in order to improve the quality of teaching environment. Therefore, students can get a better opportunity to enhance their creativity and critical thinking skills to solve emerging problems connected to agriculture, which will ultimately contribute to holistic societal development in Bangladesh.

Significance of this Study

Faculty members can use this information to revise their choice of teaching practice to support the development of critical thinking in students. The Institutional Quality Assurance Cell (IQAC), BAU, and the Agriculture Faculty at BAU may use the findings to ensure a learning environment that facilitates quality teaching and learning. Thus, in the long run, the graduates will be able to gain better job placement and be better equipped to solve the emerging national and global problems in the field of agricultural science.

Increasing higher-order thinking skills in graduates of BAU prepares them more effectively for post-graduate employment. BAU has been producing most of the workforce in the governmental agricultural extension services in Bangladesh. Graduates with better critical thinking skills will be better equipped to solve the emerging national and global problems in the field of agricultural science. Increasing employability skills of BAU graduates will help to address the first sustainable development goal of the United Nations, which is eliminating poverty (United Nations, 2018). Moreover, being able to use critical thinking skills to solve agricultural issues will increase food production in Bangladesh, which will address the second sustainable development goal of the United Nations that is eliminating hunger (United Nations, 2018). Finally, the study recommendations can inform changes that could impact student learning and hence workforce of Bangladesh. Graduates with higher-order thinking abilities can solve real-world problems related to agriculture more efficiently and contribute to national development. Thus, this study is very important for BAU and Bangladesh.

Definition of Important Terms

Academic Disciplines - Academic disciplines are clusters of the departments, which offer courses from a similar field. At the Agriculture Faculty of BAU, there are three major academic disciplines, including biological science, engineering science, and social science.

Active Faculty Members - Active faculty member means faculty members, not on leave. Types of leave include study leave, lien, extraordinary leaves, sabbatical leave, etc. during the study period.

Analyzing - Analyzing is the fourth cognitive level of RevBT. Learners scrutinize and break knowledge into multiple parts by identifying purposes or causes at the analyzing level of RevBT. They also develop inferences and find evidence to support generalizations. This level is considered as higher-level of Bloom's Taxonomy and RevBT.

Applying - Applying is the third cognitive level of RevBT and considered as lower level of RevBT. At the applying level, learners solve challenges to unique contexts by implementing previously obtained knowledge and techniques in a diverse approach.

Assistant Professors – Assistant professors at BAU have two years active classroom teaching experience and have authored at least two peer-reviewed journal articles (i.e., accepted or published). Applicants for the assistant professor rank must have an MS degree in the specific academic discipline and a Ph.D. degree is preferred.

Associate Professors - The associate professors are the second highest professional rank for the faculty members at the Agriculture Faculty of BAU. To be promoted or recruited as an associate professor, an assistant professor must have five years of teaching experience as an assistant professor and have authored three peer-reviewed scientific articles. Associate professors either have a Ph.D. degree or an additional two years of teaching.

Biological sciences – For this study, this academic discipline includes biological subjects, such as agronomy, horticulture, soil science, entomology, genetics and plant breeding, plant pathology, agricultural chemistry, biochemistry and molecular biology, environmental science, animal science, and biotechnology.

Bloom's Taxonomy - Bloom's taxonomy provides a common standard for educators to discuss and exchange learning and assessment methods. Bloom's taxonomy has six cognitive levels, including knowledge, comprehension, application, analysis, synthesis, and evaluation, which are organized from lower to higher-order thinking. This taxonomical framework is used to assess learning on a variety of cognitive levels. Educators use Bloom's Taxonomy to create higher-order critical thinking abilities among the students (Adams, 2015; Bieraugel & Neill, 2017; Wang & Farmer, 2008).

Creating - Creating is the sixth cognitive level of RevBT. At the creating level, learners assemble information collectively by joining elements in a transformed pattern or recommending appropriate solutions. Creating is considered as higher level of RevBT.

Effective Learning Environment - Effective learning environment is a situation, which has been created by the teachers to affect the development and performance of the students positively. Effective learning environment enhances the higher-order learning abilities for the students (Stronge, 2007).

Engineering science - For this study, this academic discipline includes engineering and mathematics-based subjects, such as farm power and machinery, computer science and mathematics, and agricultural statistics.

Evaluating – Evaluating is the fifth cognitive level of RevBT. At the evaluating level, learners make judgements about information, legitimate ideas, and quality of work based on set of processes. Evaluating is considered as higher cognitive level of RevBT.

Faculty - Faculty consists of the members of multiple academic departments, which work together to offer an undergraduate degree program. Compared to the USA university system, faculty is equivalent to the college (e.g., Agriculture Faculty of BAU is like the College of Agriculture and Life Science of Virginia Tech).

Higher-order Teaching Practices – These are teaching practices that promote higher-order thinking abilities and critical thinking skills among the learners (Wang & Farmer, 2008).

Lecturer - Lecturer is the entry-level position for the Agriculture Faculty of BAU. Lecturers must have minimum of a B.Sc. Ag. (Hons.) or equivalent degree on the respected fields. An MS degree in the recruiting academic department is preferred.

Professional Rank - Professional rank is the academic position of the faculty members in the Agriculture Faculty of BAU. They include lecturer, assistant professor, associate professor, and professor.

Professor - This is the highest professional rank for the faculty members. To be promoted as a professor, associate professors must have four years of teaching experience and have authored five peer-reviewed scientific articles in his four-year service period. It is desired that professor have a Ph.D. degree. Otherwise, they must have an additional two years of teaching experience.

Remembering - Remembering is the lowest cognitive level of RevBT. This level exhibits memory of the learners for earlier studied material by remembering phrases, facts, fundamental ideas, and answers. Remembering Level is considered as lower-cognitive order of RevBT.

Revised Bloom's Taxonomy - Anderson and colleagues proposed RevBT by altering the position between the top two levels of Bloom's Taxonomy. In RevBT, creating is proposed as the highest level of knowledge, while remembering remains at the lowest level. Moreover, it renamed the levels of Bloom's Taxonomy from noun form to active verb form, which includes remembering, understanding, applying, analyzing, evaluating, and creating (Agarwal, 2019; Anderson et al., 2001; Swart, 2010).

Social sciences - For this study, this academic discipline includes social science related subjects, such as These include agricultural extension education, rural sociology, agricultural economics, and languages.

Teacher - A professional identity of a person who teaches or instructs on a subject (Beijaard et al., 2004).

Understanding - Understanding is the second cognitive level of RevBT. At this level learners demonstrate their understanding about the concepts and facts by converting, organizing, clarifying, describing, and comparing core ideas. Understanding level is considered as lower-cognitive order of RevBT.

Chapter 2 - Literature Review

In this chapter, I provide a review of the literature related to higher education related to agriculture in developing countries and the use of Bloom's Taxonomy and RevBT as methods for analyzing the levels of teaching supported by higher education and classroom practices used by faculty.

Challenges of Higher Education in Agriculture in Developing Countries

Globally, 30,586 universities provide higher education to the students as measured by Webometrics.com in July 2020. Moreover, of these universities, 21,059 are situated in developing countries (Webometrics, 2020). Quacquarelli Symonds Limited ranked the universities based on "academic reputation, employer reputation, faculty-student ratio, citations per faculty, international faculty ratio, and international student ratio" (QS Quacquarelli Symonds Limited, 2019, para. 1). Surprisingly, only ten universities from developing countries are included in the top 100 world universities (QS Quacquarelli Symonds Limited, 2019). These are Tsinghua University, Peking University, Fudan University, Zheijiang University, Shanghai Jiao Tong University, National Taiwan University, Universiti Malaya (UM), University of Science and Technology of China, Universidad de Buenos Aires, and Lomonosov Moscow State University. Moreover, according to QS Quacquarelli Symonds Limited (2019) the top 50 list of agricultural universities includes only five from developing countries. Out of five agricultural universities, four of these are from China, including China Agricultural University, Nanjing Agricultural University, South China Agricultural University, and Zheijiang University and one is from Brazil (The University of Sao Paulo). Unfortunately, no university from Bangladesh is placed within the list of top 1000 world-ranked universities based on QS Quacquarelli Symonds Limited ranking.

Maguire and Atchoarena (2003), Roberts (2016), Johanson and Shafiq (2010) found the following challenges in HAE of the developing countries:

- inadequate facilities for field laboratories or out of classroom laboratories
- lack of laboratory equipment for study
- poor institutional management system, including maintenance and upkeep of the facilities
- lack of governance
- poor budget allocation for education and research
- poorly trained instructors with limited knowledge related to industry
- weak linkage between the theory and practical curricula
- easy admission criteria to absorb more students

Additionally, higher education related to agriculture in developing countries fails to promote group work, independent learning, critical thought, and students' problem-solving abilities (Federal Ministry for Economic Cooperation and Development, 2018). China is one of the promising developing countries in Asia. However, studies in China find that education there fails to provide a flexible, problem solving, critical thinking, and independent learning environment for students (Wang, 2007; Wang & Farmer, 2008). Crowder et al. (1998) predicted that agricultural universities, colleges, and schools of the developing world would face severe challenges in the twenty-first century, including contextual constrains, changes in curricular contents and emphasis, and changes in educational process. These constraints identified through a round table discussion by a group of regional expert consultants. The Sundstol & Centre for International Environment and Development Studies (2004) stated that graduates from the higher education related to agriculture of African countries (e.g., Ethiopia, Malawai, Tanzania, and Uganda) are more focused on theoretical learning with limited practical, managerial, and entrepreneur knowledge and skills. Maguire and Atchoarena (2003) also argued that although higher education related to agriculture has increased the production of the crop and livestock in the developing countries, however, yet unable to develop inclusive curricula that bring positive changes in agricultural sectors and transform the rural communities.

Education is one of the important sectors of Bangladesh that needs to be improved (Sarkar et al., 2012). Higher educational institutions of Bangladesh follow text-based, subject-oriented, and teacher-centered curricula. In a preliminary study, Kuri et al. (2019) found that 89% of final exam questions asked by Agriculture Faculty of BAU from 2002 to 2016 for the theory courses at BAU were based on the lower level of RevBT. Rahman et al., (2019) reported that major challenges for the higher education system of Bangladesh are reliance on traditional, rigid, outdated teaching and learning processes, and a lack of skilled faculty members. These challenges created less opportunity for the development of higher-order cognitive skills among the students and lead to poor employability of graduates in Bangladesh (Rahman et al., 2019). Moreover, Mahmud et al. (2018) also reported that employers of Bangladesh find deficiencies in “problem-solving and independent thinking, attitude towards working environment, and optimistic personality skills among the recent graduates”. Thus, higher education related to agriculture in the developing countries are facing multiple challenges, which hinder higher-order learning opportunities for students.

Contributions of Higher Education Related to Agriculture to Sustainable Development

Development is a complex political term used by different people or organizations to justify different agendas. Linearly, development can be defined as the positive social change that allows people or communities to accomplish the goal of increasing human capital (Daley, n.d.). Development is not only limited to improving human capital but also encompasses improving the physical, mental, and spiritual development of all elements to establish a vibrant community. This idea is supported by holistic learning theory, which is embedded in the idea of holistic education (Johnson, 2019; Huang et al., 2013). Quality education is prioritized as fourth on the list of important Sustainable Development Goals developed by the United Nations (United Nations, 2018). United Nations Economic and Social Council (2019) reported in 2016, that 750 million adults in the world do not have access to education and two-thirds of these are women. Additionally, two-thirds of the global illiterate adults live in South Asia and sub-Saharan Africa (United Nations Economic and Social Council, 2019).

Education helps a person to improve decision-making abilities, which determines the quality of productivity of any activity (Atchoarena & Sedel, 2003). Gough and Scott (2007) have also described education as assisting individuals “to make better choices and also promote intelligent consent to collective behavior (p. 14).” However, there is an interesting relationship between education and development. Hirschman (1984) argued that education is not always strongly conditioned as a prime mover and prerequisite to development. Sometimes education and training are also induced by development. Thus, the relational dynamics between education and development are very active and indispensable to each other.

Atchoarena and Sedel (2003) stated that education can improve the quality of farmers’ labor by enabling them to produce more yields by increasing production factors, resource allocation efficiency, and helping to adopt new technology. The educational level of the household heads in the developing countries also improves agricultural production, which is also empirically proved by Atchoarena and Sedel, 2003. In the 1960s, the development thinkers and practitioners viewed agricultural growth as the principal driving force for the national economy. Johanson and Shafiq (2010) found that access to higher education had a strong and positive correlation with real per-capita income over time in most of the developing countries. Moreover, higher educational attainment increased productivity at the regional level (e.g., Sub-Saharan Africa) more than at the country level (Johanson &Shafiq, 2010).

Maguire and Atchoarena (2003) suggested that higher education related to agriculture may contribute to rural development by providing “professional and technical education, policy advice on education for rural development, support to primary, secondary, vocational, and adult education for the rural space, and arranging the lifelong education for rural space" (p. 324).

Johanson and Shafiq (2010) and Salmi (2009) determined that polytechnics, technical, and community colleges are essential for rapid knowledge and skill generation in both developed and developing countries. Short-term courses, such as information communication technology-based, virtual classes and vocational training offered by specialized colleges, also promote skill development for youth and adults. Altbach and Salmi (2011) also suggested that tertiary education fosters the globally competent, skilled, productive, and flexible graduate labor force in developing countries. Thus, higher education related to agriculture should improve agricultural skills among agricultural graduates to accelerate better agricultural and rural development (Johanson & Shafiq, 2010; Salmi, 2009, and Altbach & Salmi, 2011).

Transformative Learning Theory as a Non-formal Adult Learning Theory

Transformative learning theory is based on a comprehensive and complex statement on how the learners construct, justify, and redraw their previous experience (Cranton, 1997). According to Taylor (1998), Mezirow's transformative learning theory is founded on three common themes: "the centrality of experience, critical reflection, and rational discourse" (p. vii). Mezirow (1991) also stated that

> "Perspective transformation is the process of becoming critically aware of how and why our assumptions have come to constrain the way we perceive, understand, and feel about our world; changing these structures of habitual expectation to make possible a more inclusive, discriminating, and integrating perspective; and, finally, making choices or otherwise acting upon these new understandings" (p.167).

According to O' Sullivan, et al. (2003), "Transformative learning involves experiencing a deep, structural shift in the basic premises of thought, feeling, and actions (p. xvii)."

Transformative learning is a dynamic learning process. According to Mezirow et al. (2009)

> "Transformative learning may be understood as the epistemology of how adults learn to reason for themselves—advance and assess reasons for making a judgment—rather than act on the assimilated beliefs, values, feelings, and judgments of others. Influences may include power and influence, ideology, race, class and gender differences, cosmology, and other interests" (p.23).

Merriam et al. (2007) stated that transformative learning brings an in-depth understanding that transforms the learners into active agents in constructing a different and more just reality. Merriam and Bierema (2014) also stated that transformative learning brings change at both individual and societal levels. Kasworm and Bowels (2012) described that transformative learning is mostly practiced in the classrooms of higher educational institutions. Higher education encourages people to think, to be, and to act in a new and enhanced way. Additionally, transformative learning also helps the learners to shift previous beliefs and assumptions about self and world.

Astin's I-E-O Model for Education

Astin's I-E-O model for education explains the students' learning process. It helps to understand how students gain desirable outcomes through their previous experiences, demographics and school environment (Strayhorn, 2008). In this model, inputs denote students' demographics, family background, and previous experience (Astin, 1993). The environment factor consists of the experiences, which students gather during their college time (Astin, 1993). These experiences mainly include learning opportunities for the students, academic advising, instructional quality, quality of curriculum, faculty-student interaction, student-student interaction, and extra-curricular activities (Astin, 1993). Thirdly, outcomes cover students' knowledge, beliefs, attitudes, learning retention, behavior, and values, which exist in students after graduating from the college (Astin, 1993).

Astin's I-E-O model indicates that students' outcomes are directly influenced by teaching quality that governs the environment (Astin, 1993; Kelly, 1996). Quality teaching practices create an environment that supports students' motivation towards the learning achievement (Yanto et al., 2011). Huitt (2003) and Wang and Farmer (2008) stated that effective teaching practices connect with higher-order students' achievements as it supports critical thinking and creativity among the students.

Foundation Basis of Bloom's Taxonomy and Revised Bloom's Taxonomy

Bloom's Taxonomy was published in 1956 by Benjamin Bloom (Forehand, 2010). Bloom's Taxonomy was developed to design and assess curriculum and students' learning assessment tool (Anderson et al., 2001). Thus, using Bloom's Taxonomy, the educators could classify the tests and objectives of the curricula to identify the breadth and lack of breadth of the curricular objectives and test items (Krathwohl, 2002). Bloom's Taxonomy had six categories of cognitive domains, including knowledge, comprehension, application, analysis, synthesis, and evaluation (Anderson et al., 2001). These categories were nouns forms. These categories were ordered based on cumulative hierarchy, which means the learners must acquire majesty in one category to promote the next one (Anderson et al., 2001; Krathwohl, 2002). However, Bloom's Taxonomy put less emphasis on knowledge dimension, including factual knowledge, conceptual knowledge, and procedural knowledge and put more emphasis on the six categories of the cognitive domain (Anderson et al., 2001; Krathwohl, 2002).

Factual knowledge consists of the basic aspects of a discipline, which learners have to learn to be familiarized with a discipline (Anderson et al., 2001). Anderson et al. (2001) defined the conceptual knowledge as the interrelationships between the basic elements of a larger body of knowledge, which enable all elements to function together. Procedural Knowledge is the how-to-knowledge that develops skills of the learners on how to do something (Anderson et al., 2001). Procedural knowledge also helps the learners to develop the methods of inequity and set the standards to use skills, algorithms, techniques, and methods (Anderson et al., 2001). However, in Bloom's Taxonomy, the primary focus was provided in classification of tests and curricular objectives, without considering curriculum planning and instruction (Anderson et al., 2001). Moreover, the Bloom's Taxonomy also ignored the sub-categories of the cognitive levels (Krathwohl, 2002). The audiences for the Bloom's Taxonomy were also the educators of the higher educational institutions (Anderson et al., 2001).

In 2001, Anderson, a former student of Benjamin Bloom and colleagues proposed the revised form of Bloom's Taxonomy for all levels of educational institutes focusing on curriculum planning, instruction, and assessment (Anderson, et al., 2001; Krathwohl, 2002). The curricular objectives indicate that the students should be able to do something (i.e., verb) and with something (i.e., Noun) with active engagement. Therefore, the RevBT renamed all levels of cognitive domain from noun to verb form (Anderson et al., 2001). These cognitive levels were remembering, understanding, applying, analyzing, evaluating, and creating.

Anderson et al. (2001) renamed the knowledge, comprehension, and synthesis level of Bloom's taxonomy as remembering, understanding, and creating, respectively. The remembering is the verb form of knowledge. Thus, Anderson et al. (2001) renamed the knowledge level as remembering. Moreover, through empirical studies, Anderson et al. (2001) found that educators preferred to use the word 'understanding' instead of 'comprehension.' Therefore, in the RevBT comprehension was replaced by remembering Anderson et al. (2001). Moreover, RevBT was more focused on meaningful learning than rote learning and complexity of knowledge (Anderson et al., 2001). Meaningful learning is seen as constructivist learning that focuses on active engagement of the students (Anderson et al., 2001). In constructivist learning, students are expected to create new knowledge, instead of simply presenting factual knowledge by memorizing the knowledge (Anderson, et al., 2001; Krathwohl, 2002). Thus, synthesis level of Bloom's taxonomy was renamed as creating and placed at the top of the pyramid of RevBT by replacing evaluating level as the complexity of knowledge. A student can evaluate knowledge without being creative. However, a creative learner must need a substantial level of evaluative skills or critical thinking abilities (Anderson et al., 2001). Therefore, in RevBT, the top two levels were interchanged from Bloom's Taxonomy based on creative thinking abilities of the learners and placing creating at the highest level above evaluating. Anderson, et al. (2001) also divided six categories of the cognitive levels into 19 subcategories.

Moreover, the RevBT brought back the knowledge subcategories to the mainstream of categorization of curricular objectives, instruction, and test with the cognitive levels (Anderson, et al., 2001; Krathwohl, 2002). Thus, one dimensional Bloom's taxonomy was transformed to two-dimensional RevBT that consists with both subcategories of knowledge and cognitive process. The RevBT added a fourth subcategory of knowledge dimension, referred to as metacognitive knowledge (Anderson, et al., 2001; Krathwohl, 2002). Metacognitive knowledge is the knowledge and awareness about one's own cogitation and includes a strategic, contextual, conditional, and self- knowledge system (Anderson, et al., 2001). Metacognitive knowledge helps the learners to abstract their knowledge and critique the strength of their thought process self-cognition process to make better decision (Anderson, et al., 2001). Moreover, metacognitive knowledge builds the skills of 'how to learn' instead of 'what to learn' (Anderson, et al., 2001). 'How to learn' assists the learners to create new knowledge by enhancing the creative thinking skills of the students (Anderson, et al., 2001). Thus, addition of the metacognitive subcategories of knowledge justifies the hierarchy of RevBT based on complexity of knowledge instead of cumulative hierarchy.

Bloom's Taxonomy and RevBT are the benchmark standard to evaluate the cognitive orders of the teaching-learning process, curriculum planning, and test tasks (Conner et al., 2019). The hierarchy and classification as lower and higher order levels of learning have been considered differently by authors. Swart (2010) categorized the lowest two levels of the original Bloom's Taxonomy, as knowledge, and comprehension. These two levels of Bloom's Taxonomy are referred to as the remembering and understanding in the RevBT as lower-order learning skills (Figure 2-1). This is consistent with the categorization made by Conner et al. (2019), Crowe et al., (2008), and Agarwal (2019), which grouped remembering and understanding as producing lower-level learning. Lower order learning skills only require recognition, memory, and comprehension instead critical thinking abilities. Thus, the remembering and understanding level were categorized as lower-level learning skills. Swart (2010), Conner et al. (2019), Crowe et al., (2008), and Agarwal (2019) categorized the top four levels of BT, including application, analysis, synthesis, and evaluation as higher-order teaching and learning practices. These four levels are referred to as applying, analyzing, evaluating, and creating level of RevBT. However, Wang and Farmer (2008) categorized only the upper three levels of Bloom's Taxonomy, including analyzing, evaluating, and creating as higher-order learning skills, leaving the lower three levels, including remembering, understanding, and applying ranked as providing lower-order learning skills. The major differences between Bloom's Taxonomy and RevBT are presented in Table 2.1.

Figure 2-1

Revised Bloom's Taxonomy, Anderson et al., 2001

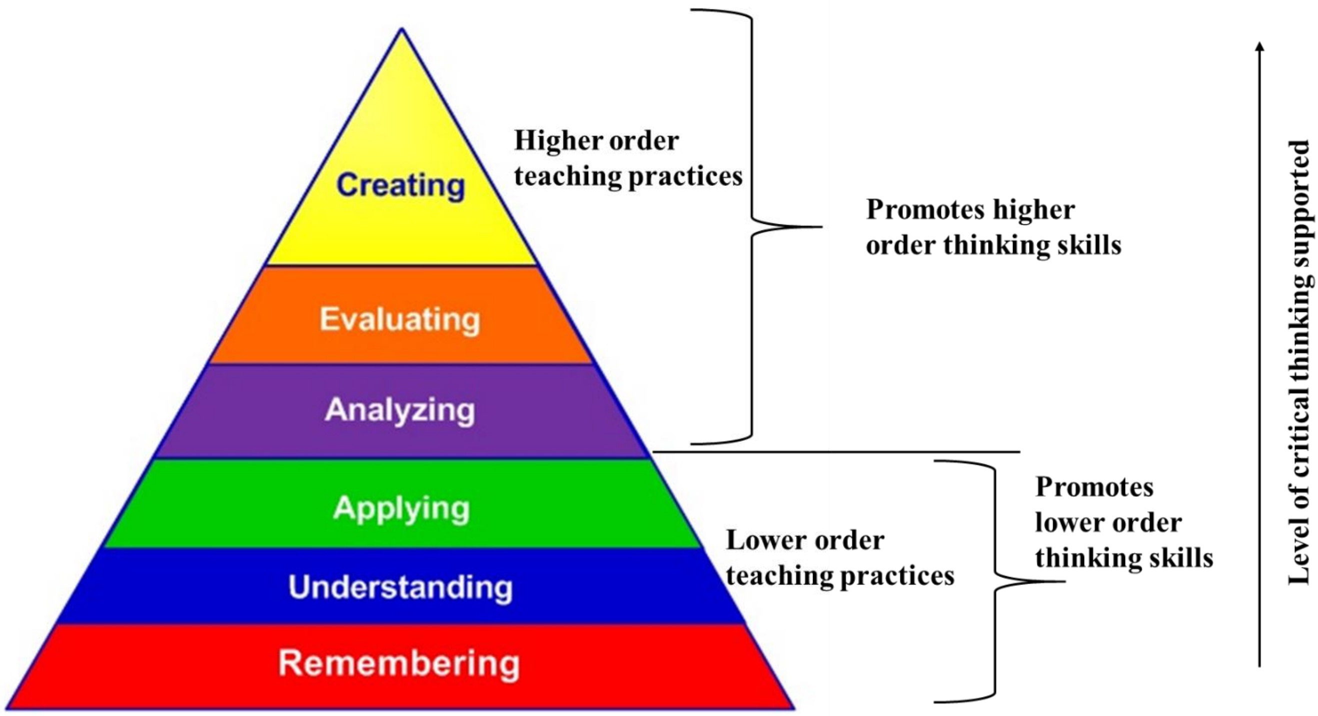


Table 2.1

Differences between Bloom's Taxonomy and Revised Bloom's Taxonomy

Criteria	Bloom's Taxonomy	Revised Bloom's Taxonomy
Proposed by	Benjamin Bloom in 1956	Anderson and Colleagues in 2001
Sub-division of knowledge	factual, conceptual, and procedural	factual, conceptual, procedural, and metacognitive
Name of the cognitive levels according to hierarchy	Knowledge < comprehension < application < analysis, synthesis < evaluation	Remembering < understanding < applying < analyzing < evaluating > creating
Type of terminology	Noun form	Action verb form
Dimensional representation of knowledge pyramid	One-dimensional: Cognitive process dimension	Two-dimensional: knowledge dimension and cognitive process dimension
Hierarchy	Cumulative hierarchy	Hierarchy based on complexity of knowledge

Note. '<' indicates 'lower level than.'

This table is developed from the narrative findings from Anderson, et al., (2001); Krathwohl (2002); Wang and Farmer (2008); Forehand (2010); and Adams (2015).

Higher-order teaching Practices

Teaching practices are the style or form of instruction, including lesson plans, assessment, teaching material preparation, and delivery, interaction with students, and reflection (Zazkis & Leikin, 2010). Huitt (2003) and Wang and Farmer (2008) stated that effective teaching practices connect with higher-order students' achievements. The teaching practices that promote higher-order thinking abilities and critical thinking skills among the learners are called higher-order teaching practices (Wang & Farmer, 2008). The higher-order teaching practices strengthen the learners that motivate the learners to acquire and consolidate deep learning (Preus, 2012; Hattie and Donoghue (2016). Higher-order teaching also helps learners transfer their knowledge from one area to another area (Hattie & Donoghue, 2016). Preus (2012) and Yen and Halili (2015) recommended using innovative students' assessment techniques in classrooms to create higher order teaching practices. Yen and Halili (2015) also suggested providing surprise reading materials and quizzes for the students to recognize the level of student engagement, preparation, and understanding of previous lessons. Moreover, faculty members using higher order teaching practices should also conduct short essay writing tests periodically and provide appropriate feedback (Preus, 2012). Short essay writing tasks help students apply their theoretical knowledge from one context to another context. Faculty members should also provide open-ended questions that involve critical brainstorming to assess the critical thinking abilities (Preus, 2012; Yen & Halili, 2015; and Tambouris et al., 2012). Faculty should also set complex learning goal for the students to create critical thinking abilities among the students (Preus, 2012). Moreover, faculty members should create a congenial atmosphere at the classrooms that promotes cooperative learning opportunities for the students. Thus, students can share their ideas in a common space, take part team-based assignments, and learn from each other to increase their creativity (Yen & Halili, 2015)

Hugerat and Kortam (2014) recommended that faculty members should also include recent scientific articles in compulsory reading materials in classes in order to assure higher order teaching practices in classrooms. Teachers should support higher order learning by assigning group-based case studies related to the real-life problems that require support from evidence-based scientific articles to resolve (Popil, 2011; Zhang, 2012; Hugerat & Kortam 2014; and Merriam & Bierema, 2014). Preus (2012) and Yen and Halili (2015) also suggested faculty encourage critical thinking by asking students to create solutions to complex issues that integrate multiple viewpoints and sources of information. Thus, students can analyze and evaluate the probable alternatives and synthesize the most appropriate solution for the problem (Preus, 2012; and Yen & Halili, 2015). Moreover, to create higher order teaching practices in class, faculty members should help students learn ‘how to think’ not ‘what to think’ (Preus, 2012). Wang and Farmer (2008) also recommended following Bloom’s Taxonomy in classrooms to create higher order teaching practices in classes. Cullinane and Liston (2016) and Jensen et al. (2014) also suggested that faculty members should conduct numerous exams throughout the semester (e.g., weekly reflection, chapter-end quiz test, mid-term papers, etc.) by formulating test questions based on higher-levels of Bloom’s Taxonomy.

Methods to Determining the Level of Teaching Practices

Anderson et al. (2001) stated that RevBT and Bloom’s Taxonomy are the standard measurement tool to assess the curricular objectives, instructional procedures, and evaluation tools. By using RevBT, the curriculum designer can determine the standard and level of intended learning objectives and outcomes, learning assessment tools, and teaching practices (Anderson, et al., 2001; Krathwohl, 2002). By placing the knowledge dimension at the vertical axis and cognitive dimensions at horizontal axis, a taxonomy table can be formed based on RevBT (Anderson, et al., 2001; Krathwohl, 2002). Thus, intersections of the subcategories of the knowledge dimensions and cognitive process dimensions would create cells of taxonomy Table of RevBT. Thus, learning objectives and outcomes, instructional practices, and assessment tool can be classified by using taxonomy table of RevBT, which determines the most appropriate cell to categorize the verb and noun or noun phrases (Krathwohl, 2002). The taxonomy table of RevBT is presented in Table 2.2.

Table 2.2

The Taxonomy Table of Revised Bloom's Taxonomy

The Knowledge Dimension	The Cognitive Process Dimension					
	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
Factual Knowledge						
Conceptual Knowledge						
Procedural Knowledge						
Metacognitive Knowledge						

Note. This table is copied from Anderson, et al. (2001) and Krathwohl (2002).

Wang and Farmer (2008) developed the LOTSHOTS tool, which contains 36 close-ended questions from the six levels of Bloom’s Taxonomy using the taxonomy table. Practitioners can use LOTSHOTS tool to determine the level of individual teaching practices. In the LOTSHOTS tool, six questions based on individual teaching practices were formulated from each level of Bloom’s Taxonomy. The respondents needed to answer each question on a six-point rating scale based on the frequency of using of a teaching practice. Thus, after averaging of values of six questions for each individual level of Bloom’s taxonomy, researchers can identify the level of teaching by using LOTSHOTS tool based on Bloom’s taxonomy. Therefore, survey respondents get higher scores on the higher levels of Bloom’s Taxonomy indicates they practice higher order teaching for classroom instruction (Wang &

Farmer, 2008). Moreover, Ahmed et al. (2014) analyzed the CLOs of the curriculum of an engineering course and Bumpus et al. (2020) analyzed the action verbs of course learning objectives of course syllabi and determined the percentages of action verbs of each level of RevBT by using verb chart of RevBT as proposed by Anderson et al. (2001).

Importance to Determine the Level of Teaching Practices

From the above discussions, it is clearly evident that higher education related to agriculture in developing countries are facing multiple challenges, which hinders higher-order learning opportunities for students (Federal Ministry for Economic Cooperation and Development, 2018; Wang, 2007; Wang & Farmer, 2008; Maguire & Atchoarena, 2003; and Rahman et al., 2019). However, higher education related to agriculture is one of the key factors to eliminate the poverty and assure the food security at the developing countries by increasing crop yields, improving farmers livelihoods and decision-making abilities (Johanson & Shafiq, 2010; Atchoarena & Sedel, 2003; Maguire & Atchoarena, 2003). Moreover, higher education related to agriculture improves agricultural skills among agricultural graduates to accelerate better agricultural and rural development (Johanson & Shafiq, 2010; Salmi, 2009, and Altbach & Salmi, 2011). RevBT is the theoretical lens that can assess the level of current teaching process of any school systems and recommend the potential updates for further improvement. Teaching practices connected to the higher level of RevBT promote higher-order thinking abilities and critical thinking skills among the learners (Wang & Farmer, 2008).

Chapter 3 - Research Methodology

This chapter begins with an overview of the purpose, research questions, and theoretical basis for the proposed study. This is followed by research design, population, sampling frame, sample size, source of data, survey tool validation, data collection, and data analysis for both primary data and secondary data. Finally, the chapter ends with a summary of the limitations of the proposed study.

Purpose

The purpose of this study was to understand the teaching practices of the Agriculture Faculty at Bangladesh Agricultural University (BAU). The long-term goal of this project is to provide findings that support the improvement of the agricultural education system to produce graduates with better critical thinking abilities who can reduce hunger and poverty by increasing food access and food production in Bangladesh. Therefore, this project will address many of the sustainable development goals adopted by the United Nations, including eliminating poverty and hunger, and increasing the quality of education (United Nations, 2018).

Research Questions

To achieve the goal of the proposed study, the overarching research question was "What level of teaching is supported by the Agriculture Faculty of BAU as related to the cognitive levels of RevBT (Anderson et al., 2001)?" The underlying research questions for this study were as follows:

1. What is the supported cognitive level of teaching practice of the Agriculture Faculty at BAU based on RevBT (Anderson et al., 2001)?
2. Does the supported cognitive level of teaching practice at BAU vary based on academic discipline, professional rank, or gender of the faculty members of the Faculty of Agriculture?
3. What discourages or encourages Agriculture Faculty at BAU from using teaching practices that support higher order cognitive levels based on RevBT (Anderson et al., 2001)?
4. What are the recommendations of the Agricultural Faculty members at BAU to create higher-order teaching practices?

Conceptual Framework of This Study

In this section I will describe the connections between my study and transformative learning theory (Mezirow, 2000), and Astin's I-E-O model for education (Astin, 1993). In addition, I will provide the connection and rationale for my use of the LOTSHOTS survey tool (Wang & Farmer, 2008), which is based on Bloom's Taxonomy (Anderson et al., 2001) for data collection. Collectively, these items provide the contextual framework for my study.

Transformative Learning Theory

Transformative learning theory is an adult learning theory in non-formal contexts (Mezirow, 2000; and Merriam & Bierema, 2014). Transformative learning is a dynamic learning process. According to Mezirow et al. (2009) transformative learning theory is "understood as the epistemology of how adults learn to reason for themselves, advance and assess reasons for making a judgment, rather than act on assimilated beliefs, values, feelings, and judgments of others" (p. 167). Merriam et al. (2007) stated that transformative learning brings an in-depth understanding that transforms the learners into active agents in constructing a different and more just reality. Moreover, educators of the western educational institutes mostly follow transformative learning theory for classroom teaching (Mezirow, 2000; Wang & Farmer, 2008; Kasworm & Bowels, 2012; and Merriam & Bierema, 2014). According to Mezirow (2000),

> "Transformative learning refers to process by which we transform our taken-for-granted frames of reference (meaning perspectives, habits of mind, mindsets) to make them more inclusive, discriminating, open, emotionally capable of change, and reflective so that they may generate beliefs and opinions that will prove more truly justified to guide action" (p.8).

According to Mezirow (2000), transformative learning often follows some variation of the following phases, including "disorienting dilemma, self-examination, sense of alienation, relating discontent to others, explaining options of new behavior, building confidence in new ways, planning a course of action, knowledge to implement plans, experimenting with new roles, and reintegration" (p. 22). However, these are categorized into four major stages of transformative learning theory: 1) disorienting dilemmas, 2) critical assessment and examination of assumptions, 3) exploring options and plans, and 4) acquisition new knowledge and implementation of plan (Mezirow, 2000). Mezirow (2000) described that the situation where new knowledge and thoughts conflict to the existing knowledge and experience of the learners is called disorienting dilemma. Afterward, the learner critically assesses and reviews the existing knowledge, thoughts, and surroundings to understand their flaws and thereby more open to accept the new knowledge and develop assumptions (Mezirow, 2000). Subsequently, the learners look for plans and options to strengthen the new knowledge. At this phase, learners go through extensive learning process to develop their knowledge and perspectives to the new knowledge (Mezirow, 2000). Finally, the learners implement their plans into actions. New perspectives help to broaden the outlook and positively transform the behavior and thinking (Mezirow, 2000).

Use of Transformative Learning Theory in This Study

Stage 1: Disorienting dilemmas. In 2014, almost 40 million people of Bangladesh were food insecure (Osmani, et al., 2016). Moreover, in 2019, 20.5% of total population of Bangladesh has been living below the national poverty line (Asian Development Bank, 2021). Moral (2019) stated that almost five million people in Bangladesh were homeless. These indicators point that Bangladesh needs holistic development that minimize major social problems, including food insecurity, poverty, and homelessness. According to the United Nations' Sustainable Development Goal, every nation should eradicate hunger, poverty, and homelessness from their countries by 2030 to achieve a sustainable future (United Nations, 2018).

Stage 2: Critical assessment & examination of assumption. Education aids in holistic societal development (Johnson, 2019). Thus, education creates opportunities for development, which can reduce hunger, poverty, and homelessness. Therefore, quality of education of the higher-educational institutes in Bangladesh needs to be assessed. Teaching and curriculum quality are crucial to maintain the desired standard of the education. Thus, critical assessment of the teaching and curriculum clearly depicts an in-depth scenario of instructional quality. Therefore, the practitioners may test their assumptions on teaching practices and curricula design for further upgradation.

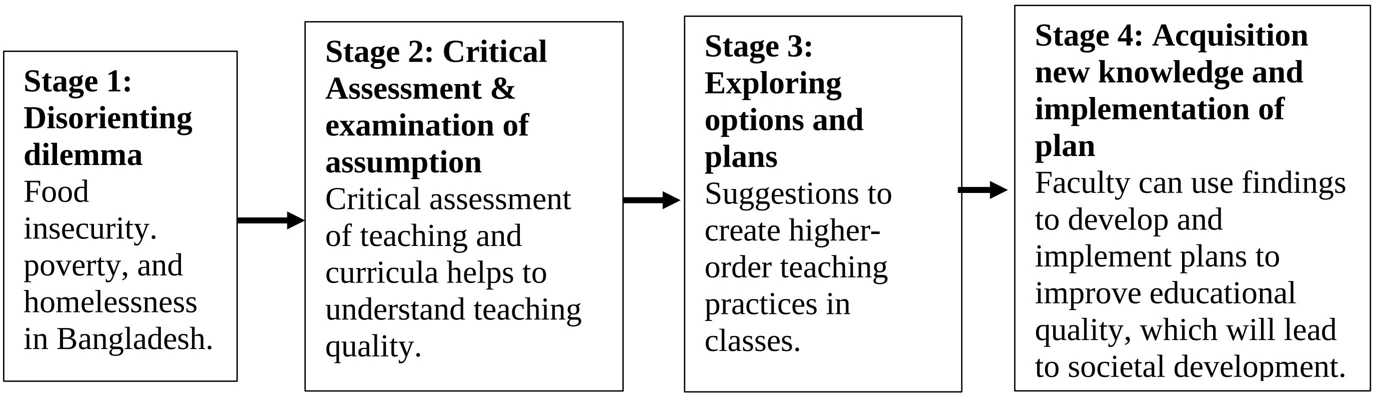
Stage 3: Exploring options and plans. The practitioners or the teachers should also propose plans and options to upgrade the teaching environment. This bottom-up approach explores the options and plans in an inclusive and sustainable way. Thus, the university authority and administration can get a sense about the teachers' expectations about the desired changes, which help to formulate more appropriate and acceptable plans.

Stage 4: Acquisition of new knowledge and implementation of a plan. The findings of this study will help the practitioners to understand the quality of teaching practices of the Agriculture Faculty at BAU. Therefore, using the findings of this study, the practitioners can develop and implement appropriate plans to improve the classroom teaching environment of the Agriculture Faculty at BAU. Thus, in the long run, the graduates will be able to gain better job placement and be better equipped to solve the emerging national and global problems in the field of agricultural science. Thus, the hunger, poverty, and landlessness will be reduced in Bangladesh.

The connection between different stages of the transformative learning theory with this study is presented in Figure 3-1. The stage 2 and stage 3 of transformative learning theory are woven into the research questions of this study. The critical assessment of the teaching and curriculum explored the level of teaching practices and tested the assumptions of variation of teaching practices based on disciplines, professional ranks, and gender of faculty members. Identifying the factors, which discourage and encourage the faculty members will help to understand the quality of teaching more elaborately. Exploring the suggestions and plans made by the faculty members to create the higher order teaching in classrooms ultimately creates options and plans towards desired changes in teaching quality. Finally, by utilizing the findings of this study, the practitioners of BAU may formulate and implement the most appropriate plans to improve the educational quality in Bangladesh. Therefore, the quality education can accelerate the overall societal development and reduce the hunger, poverty, and homelessness.

Figure 3-1

Stage 2 and Stage 3 of Transformative Learning Theory (Mezirow, 2000) are Connected to the Teaching and Curricula Assessment and Exploring Options to Improve the Teaching Quality



Astin's I-E-O Model for Education

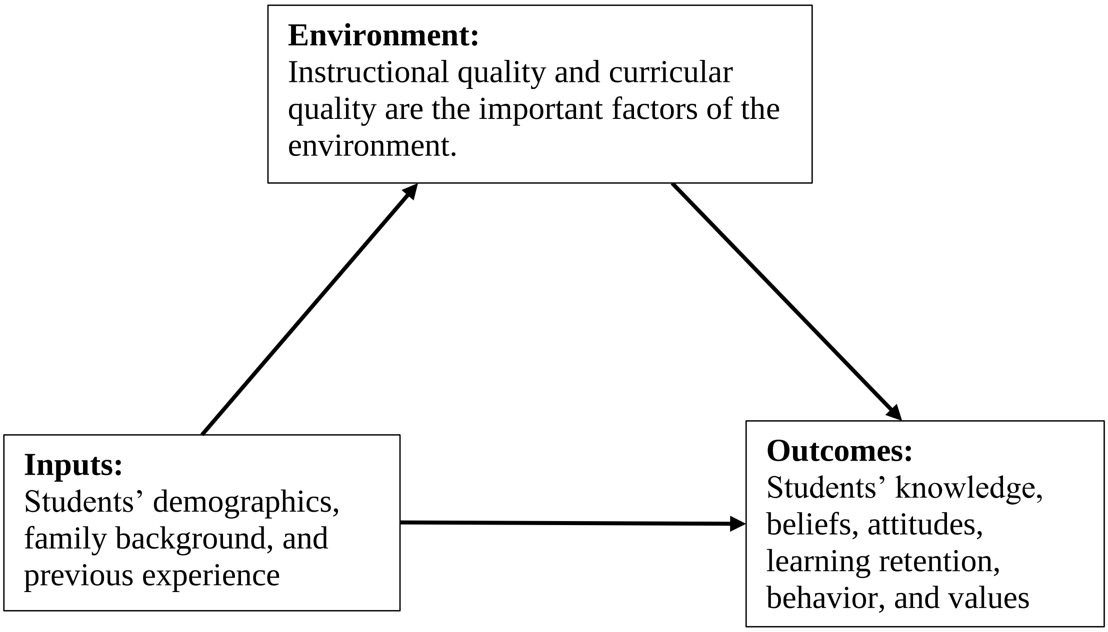
This study was connected to the 'environment' component of the Astin's I-E-O model. Astin's I-E-O model or theory of student involvement explains the students' learning process. It helps to understand how students gain desirable outcomes through their previous experiences, demographics, and school environment (Strayhorn, 2008). In this model, inputs denote students' demographics, family background, and previous experience (Astin, 1993). The environment factor consists of the experiences, which students gather during their college time (Astin, 1993). These experiences mainly include learning opportunities for the students, academic advising, instructional quality, quality of curriculum, faculty-student interaction, student-student interaction, and extra-curricular activities (Astin, 1993). Thirdly, outcomes cover students’ knowledge, beliefs, attitudes, learning retention, behavior, and values, which exist in students after graduating from the college (Astin, 1993).

Astin’s I-E-O model indicates that students’ outcomes are directly influenced by teaching quality that governs the environment (Astin, 1993; Kelly, 1996). Quality teaching practices create an environment that supports students’ motivation towards the learning achievement (Yanto et al., 2011). Huitt (2003) and Wang and Farmer (2008) stated that effective teaching practices connect with higher-order students' achievements as it supports critical thinking and creativity among the students.

The relationship between Astin’s I-E-O model and this study is presented in Figure 3-2. It shows that teaching quality and curricular quality are two important elements of the environment factor of Astin’s I-E-O model. Thus, quality teaching and curriculum contribute to better college environment. Therefore, it is required to assess the quality of the teaching practices and curriculum of BAU to understand how extent it supports standard teaching environment. The findings of this study will help the practitioners to take necessary steps in order to improve the quality of teaching environment. Therefore, students can get a better opportunity to enhance their creativity and critical thinking skills and solve real world problems related to agriculture, which will ultimately contribute to holistic societal development in Bangladesh.

Figure 3-2

Quality of Teaching and Curriculum of the Environment Factor of Astin's I-E-O Model (Astin, 1993) Needs to be Assessed to Ensure Desired Students' Outcomes



Assessing the Quality of Teaching and Curriculum

Wang and Farmer (2008) stated that teaching methods, associated with the higher levels of Bloom's Taxonomy (i.e., analyzing, evaluating, and creating) support higher-order learning for the learners. Wang and Farmer (2008) developed the Lower-order Thinking Skills and Higher-order Thinking Skills (LOTSHOTS) tool based on Bloom's Taxonomy to assess the teaching level in China from the department of continuing education from the universities of Beijing, Shanghai, and Guangzhou cities. RevBT are the benchmark standard to evaluate the cognitive orders of the teaching-learning process, curriculum planning, and test tasks (Conner et al., 2019; Krathwohl, 2002; and Anderson et al., 2001). Wang and Farmer (2008) stated that LOSHOTS "instrument was designed to dichotomize instructors' teaching in relation to students' learning outcomes in order to give researchers a quantitative tool to analyze teaching and learning in different cultures" (p. 8). Therefore, LOTSHOTS tool was used to assess the teaching level of the Agriculture Faculty at BAU, extending its use in the context of another developing country for this study. This LOTSHOTS tool determined the level of teaching in a given situation to the learners.

The differences in levels of teaching with academic disciplines, professional ranks, and gender of faculty members at the Agriculture Faculty of BAU were also explored through this study. Along with the LOTSHOTS tool, faculty members were also asked to identify the factors which discourage and encourage to use higher order teaching practices and recommendations for increasing the use of higher order teaching practices in the classrooms of BAU by using open-ended responses from their lived experiences. These questions helped the faculty members to reflect their surrounding more critically and formulate the plan for improvement.

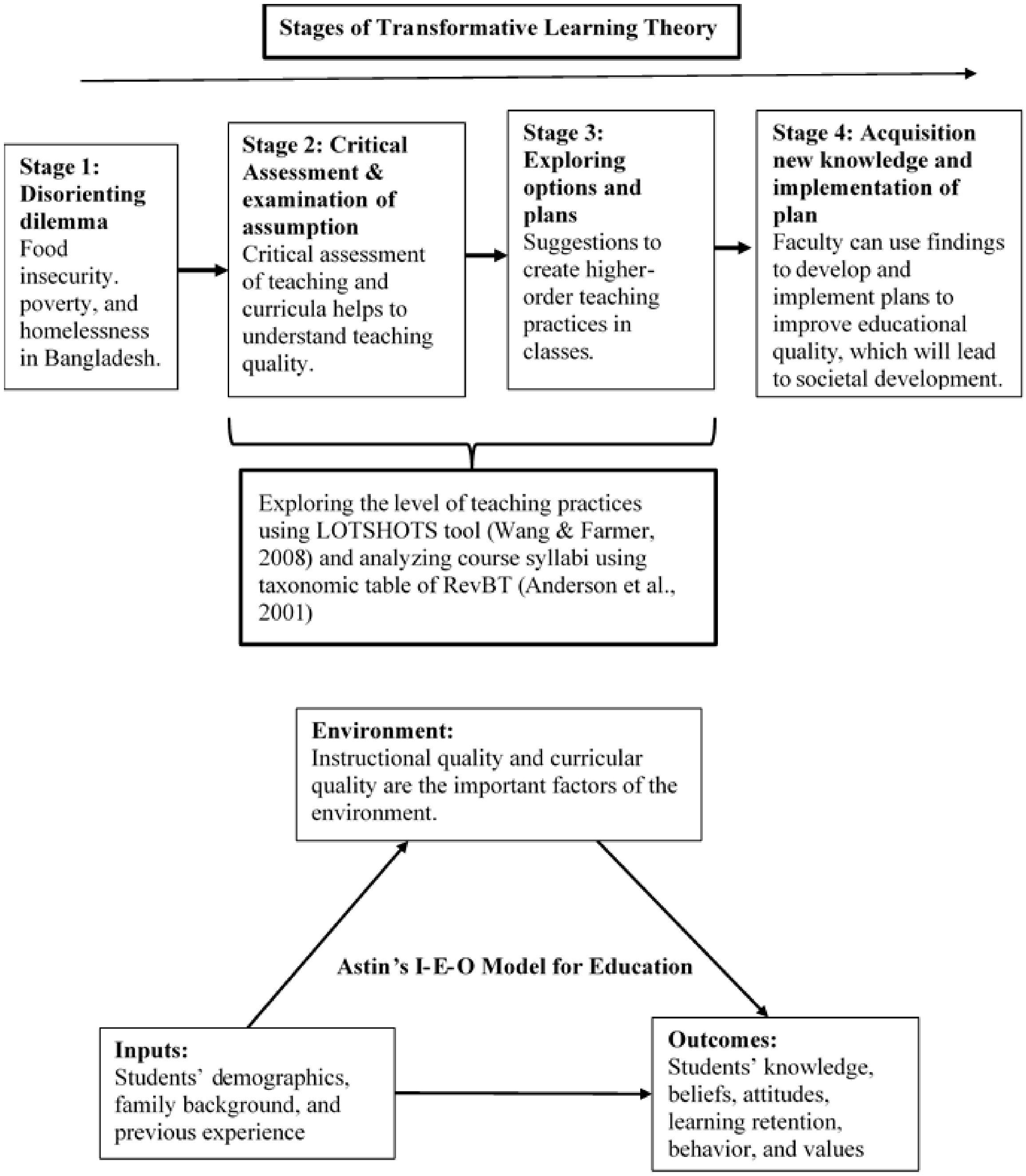
Conceptual Framework

This study is at the intersection of the stage 2 and stage 3 of transformative learning theory and the environment factor of Astin's I-E-O model. The conceptual framework of this study is presented in Figure 3-3. All specific research questions were laced with the stage 2 and stage 3 of transformative learning theory. The critical assessment of the teaching and curriculum explored the level of teaching practices and tested the assumptions of variation of teaching practices based on disciplines, professional ranks, and gender of faculty members. Identifying the factors, which discourage and encourage the faculty members will help to understand the quality of teaching more elaborately. Exploring the suggestions and plans made by the faculty members to create the higher order teaching in classrooms ultimately creates options and plans towards desired changes in teaching quality. Finally, by utilizing the findings of this study, the practitioners of BAU may formulate and implement the most appropriate plans to improve the educational quality in Bangladesh. Therefore, the quality education can accelerate the overall societal development and reduce the hunger, poverty, and homelessness.

Teaching quality can be assessed by using LOTSHOTS tool (Wang & Farmer, 2008). Moreover, open ended questions will help the faculty members to explore the plans and options to improve the teaching quality. Teaching quality and curricular quality are two important elements of the environment factor of Astin's I-E-O model. Thus, quality teaching and curriculum contribute to better college environment. Therefore, it is required to assess the quality of the teaching practices and curriculum of BAU to understand how extent it supports standard teaching environment. The findings of this study will help the practitioners to take necessary steps in order to improve the quality of teaching environment. Therefore, students can get a better opportunity to enhance their creativity and critical thinking skills and solve real world problems related to agriculture, which will ultimately contribute to holistic societal development in Bangladesh.

Figure 3-3

Conceptual Framework of This study (Assessing the Teaching and Curriculum (Stage 2) and Exploring the Plans and Options (Stage 3) (Transformative Learning Theory) to Improve the Teaching using LOTSHOTS Tool will Advance the College Environment (Astin's I-E-O Model), which Affect the Students' Outcomes)



Research Design

The purpose of this study was to understand the teaching practices of the Agriculture Faculty at Bangladesh Agricultural University (BAU). For the proposed research project, I used an instrumental case study that focuses on a single case of analysis, namely the Agriculture Faculty at BAU. Yin (2018) propose a two-fold definition of the case study. In the first fold of definition Yin (2018) states that a case study explores the real-world case in which context is indispensable. In a laboratory experiment, the context is controlled by the researcher. However, the case study considers the context and explores the relationship between the phenomenon and the context. Moreover, Yin’s second phase of the definition explains the sharp differentiation between the phenomenon or issue and context, which focuses on the relevant methodological features of a case (Yin, 2018).

Case study focuses on multiple sources of evidence and triangulates the findings. Additionally, a case study relies on multiple variables of interest rather than a single result and data point. An instrumental case study explores a single case, including person, group, or an organization to develop insight into a particular issue (Yin, 2018). Teaching process of the Agriculture Faculty at BAU is the single-core instrumental case, which was explored by using the proposed research design for this study. The identified case was bounded with current and real-life events. I explored the case to understand a single issue, the teaching process of the Agriculture Faculty at BAU, within the context of the Agricultural Faculty of BAU bounded by the time in which the study occurs, the summer of 2020. Thus, the proposed case study was categorized as an instrumental case study according to the classification of Creswell (2013), Grandy (2010), Guetterman and Fetters (2018), and Yin (2018). The issue of interest was the teaching process of the Agriculture Faculty in BAU as the place within the timeframe of 2020. Flyvbjerg (2011) stated that “case studies favor intensity and depth, as well as exploring the interaction between case and context” (as cited in

Marshall and Rossman, 2016, p. 19). An instrumental case study explores a single case to gain insight into an issue (Yin, 2018).

Faculty of Agriculture, BAU was purposively selected for this study as it produces highest number of agricultural graduates every year in Bangladesh. Moreover, the researcher is working as a faculty member of the Agriculture Faculty at BAU. Furthermore, the researcher was an undergraduate and post graduate student of the Agriculture Faculty at BAU. Therefore, the researcher has a huge personal interest to assess the teaching and curriculum of the Agriculture Faculty at BAU.

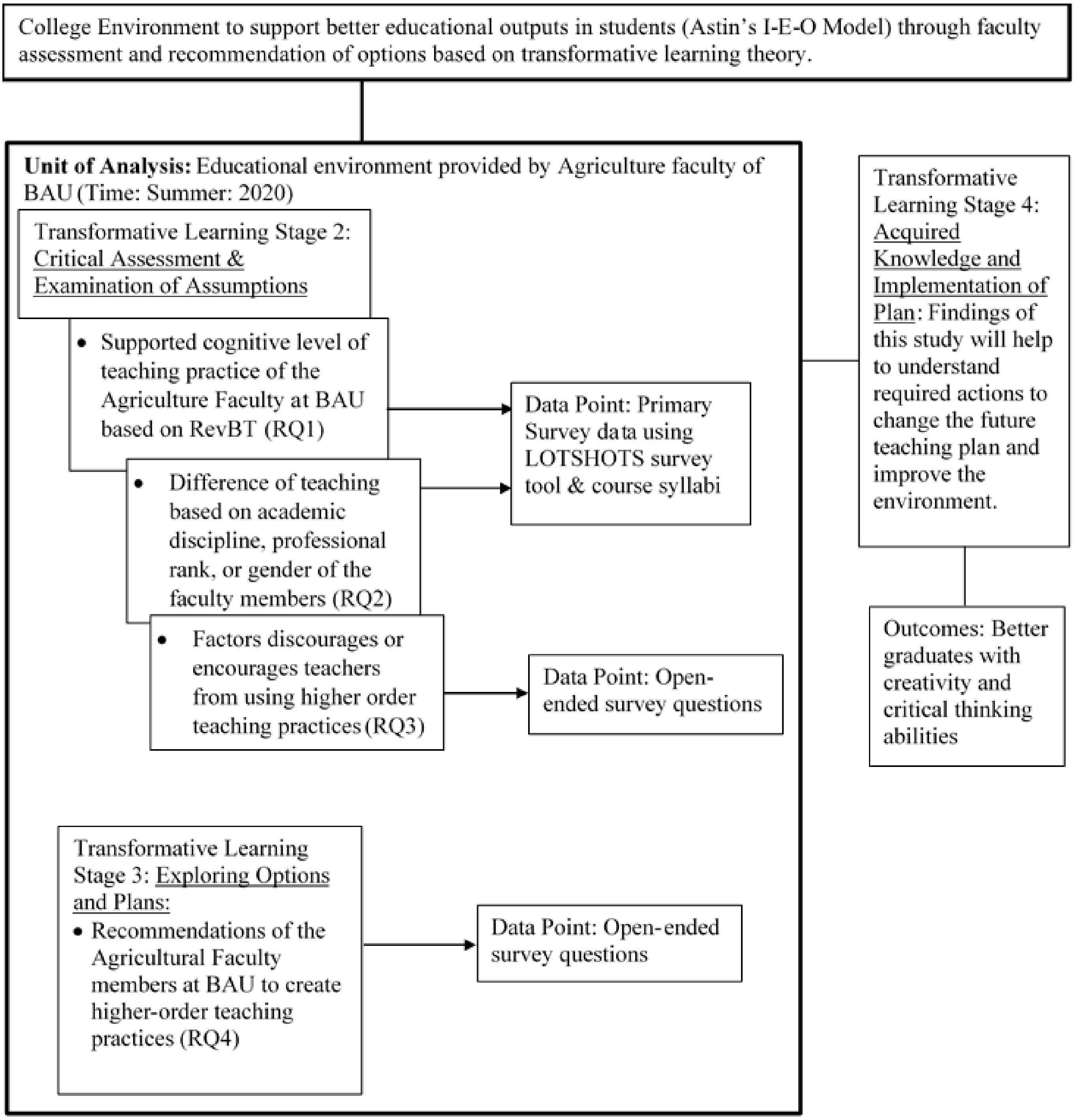
The unit of analysis of this study was the educational environment provided by Agriculture faculty of BAU that offers a single under-graduate degree program called B.Sc. Ag. (Hons.). To explore the teaching practices, data was collected from the faculty members of BAU on their classroom instruction process by using LOTSHOTS survey tool (Wang & Farmer, 2008). Moreover, all course syllabi were analyzed using verb charts associated with RevBT (Anderson et al., 2001) of the Agriculture Faculty of BAU to understand the intended level of teaching. Finally, through open-ended questions added to the LOTSHOTS survey, I explored the factors, which discourage and encourage faculty members to create higher order teaching practices at BAU along with their recommendations to create higher order teaching practices. Thus, an in-depth analysis of the teaching process of the agriculture faculty of BAU was explored through this study.

Any sampling methods, including purposive sampling, random sampling, stratified sampling, and snowball sampling may create sampling error during sample determination (Creswell, 2014). Sampling error affects the data collection, analysis, and interpretation. Therefore, a study should be free from sampling error. To minimize the sampling errors, census survey was conducted to collect the data for this study. Thus, all the members of the sampling frame had equal opportunity to participate in this study.

This case study is primarily built on the environment factor of Astin's I-E-O model that shows environment to support better educational outputs in students through faculty assessment and recommendation of options based on transformative learning theory. The assessment of the teaching process of the Agriculture Faculty at BAU helps to understand required actions to change the future teaching plan and improve the environment of the college. Finally, a better college environment will help the students to achieve their desired outcomes and strengthen their skills as a critical thinker. The diagram of case and research design are presented in the Figure 3-4.

Figure 3-4

Research Design (An Instrumental Single-core Case Study Research Design)



Population, Sampling Frame, and Sample Size

Structurally, the Faculty of BAU is equivalent to a College of Agriculture in the higher educational institutions of the USA. Under each faculty, multiple departments offer different courses to fulfill the requirement of a single degree. Currently, there are 297 faculty members in 20 departments that teach in the Agriculture Faculty of BAU. There are no major or minor focuses for any single degree offered by BAU. For example, all enrolling students of Agriculture Faculty at BAU will achieve a common degree called B.Sc. Ag. (Hons.) with a basis in crop sciences. The population of interest in this study is all faculty members of Agriculture Faculty of BAU. The inclusion criterion for the sampling frame was that respondents must be actively teaching in summer, 2020.

The population list was obtained from the website of the Bangladesh Agricultural University (www.bau.edu.bd). The draft sampling frame was developed by discarding the faculty members from the population list who did not satisfy the inclusion criteria of this study. The sampling frame was validated by asking the departmental heads to review the personal credentials of the faculty members on the draft frame within five business days (Appendix A). After getting responses from all departmental heads, the sampling frame was revised and finalized. The final sampling frame consisted of 237 faculty members actively involved in classroom teaching at the Agriculture Faculty of BAU in summer, 2020.

Sources of Data

LOTSHOTS survey tool (Wang & Farmer, 2008) was used to collect the data from the faculty members of the Agriculture Faculty at BAU for Research Question 1 (RQ1) and Research Question 2 (RQ2). This data helped me to understand the level of teaching practices used by the faculty members. This data also explored the relationship between the teaching practices with academic disciplines, professional rank, and gender of the faculty members. Open-ended questions were also used to explore the Research Question 3 (RQ3) and

Research Question 4 (RQ4). Moreover, all course syllabi were analyzed to understand the recommended teaching practices for classroom instruction at BAU. Thus, the survey used in this study consisted of 39 questions, including 36 close-ended questions and three open-ended questions.

Survey Tool Development and Validation

Survey Tool Development. Wang and Farmer (2008) developed the LOTSHOTS survey tool to identify levels of learning supported by teaching based on Bloom's Taxonomy. The LOTSHOTS tool is composed of 36 close-ended questions, which are based on six cognitive levels (i.e., remember, understand, apply, analysis, synthesis, and evaluate) of Bloom's Taxonomy (Wang & farmer, 2008). Wang and Farmer (2008) identified six questions from each level of Bloom's taxonomy and randomized the questions to identify the level of learning supported by teaching methods. The LOTSHOTS tool was used, delivered via Qualtics^{XM} for survey, and randomized as originally as presented by Wang and Farmer (2008). Moreover, to collect the demographics of the survey participants, their academic department, professional, and gender were asked before presenting the LOTSHOTS tool.

Finally, three open-ended questions were asked to identify the factors which discourage and encourage faculty members for using higher order teaching practices and recommendations to create higher order teaching practices in classrooms. The open-ended questions are as follows:

- What challenges do you face to use more higher order teaching practices in your classes?
- What benefits do you see in using more higher order teaching practices in your teaching?
- What are the major recommendations that you provide to create higher order teaching practices in the Agriculture Faculty of BAU?

Moreover, before introducing the open-ended questions to identify the factors, which discourage and encourage the faculty members to use higher order teaching practices in classroom, a checklist was presented in the questionnaire on the recommended higher order teaching practices in classrooms. The checklist showed a list of recommended higher order teaching practices. This checklist helped the survey respondents to recall the higher order teaching practices. The checklist is presented as follows:

- Follow students' centered pedagogy with complex goal and promote collaborative learning atmosphere in the classroom
- Provide surprise reading materials and quiz tests for the students to recognize the level of engagement, preparation, and understanding of students about previous lessons
- Encourage critical thinking of students to create solutions to complex issues integrating multiple viewpoints and sources of information
- Conduct short-writing test periodically and provide appropriate feedback
- Assign group-based case studies related to the real-life problems that require support from evidence-based scientific articles to solve the issue
- Provide open-ended questions that involve critical brainstorming to assess the critical thinking abilities
- Include recent scientific articles in compulsory reading materials
- Conduct numerous exams throughout the semester (e.g., weekly reflection, chapter-end quiz test, mid-term papers, etc.) by formulating test questions based on higher-levels of Bloom's Taxonomy
- Help students to learn 'how to think' not 'what to think'
- Others (Please provide other higher order teaching strategies that you are using in your class)

Survey Tool Validation. The survey tool was validated prior to distributing it to the intended audience through a pilot survey. The LOTSHOTS survey tool was used to survey within a different cultural context than where it was used previously by Wang & Farmer (2008). Three new questions were added to the LOTSHOTS survey tool. Thus, it was required to validate the new survey tool.

To validate the survey tool, the tool was sent to five randomly selected faculty members from the population list who were currently on study leave and excluded from the study. The pilot survey participants had asked them to complete the survey within five business days. All five members responded to the survey before the deadline. Their responses were exported to the SPSS.16® software for further analysis. Cronbach's Alpha (α) value for the pilot survey was 0.974, which indicates almost perfect internal consistency of the responses (Bonett & Wright, 2015). Cronbach's Alpha values greater than 0.7 that indicates high internal consistency of responses. Two open-ended questions were added to the pilot survey to gather their feedback on the understandability of the survey instrument. None of the survey respondents suggested any further revisions for the questions.

Data Collection

The mixed-method survey technique was used to collect the data from the survey respondents (McCabe et al., 2006; Keough & Tanabe, 2011) to collect the data. Mixed-method survey research design means using two survey methods together (Keough & Tanabe, 2011). Faculty members were recruited to complete the census-survey developed online in Qualtrics$^{XM®}$. The web-based online survey was conducted first, which was followed by sending an e-mail with a word file of the questionnaire to the members of the sampling frame as recommended by Creswell (2014); Dillman et al., (2014); Sage Publications & Sage eReference (2009); and Fowler (2009). Before conducting the data collection, the Virginia Tech Institutional Review Board reviewed and approved this study as Non-Human Subject Research (Virginia Tech IRB no. IRB# 20-562). The following process was followed for administration of the survey as recommended by Dillman et al., (2014):

1. All members of the sampling frame received an introductory email (Appendix B). This introductory email contained the purpose of the project. This email also indicated that that they would be receiving an invitation to participate within 3 days. A copy of the consent form (Appendix C) for the study was attached to this email for their review. Members of the sampling frame received an email invitation (Appendix D) to participate in the study with the consent form attached again 3 days later.
2. The email invitation included a personal link that respondents could use to access the survey. They were asked to complete the survey within ten days of receiving the invitation (Appendix E). At the beginning of survey, they were asked to consent to

respond to the core questions related to this study. If they responded no, they were thanked for their participation and directed to the end of the survey. However, if they selected yes, they were directed to the basic part of the survey questions. An appreciation email was subsequently sent to all participants as they finished the survey (Appendix F).

3. After seven days, 206 individuals of the first email recipients had not responded to the survey and were sent an automatic reminder email (Appendix G). A Microsoft Word-document version of the original survey tool to the reminder email was attached and asked the potential survey respondents to respond to the questions and return this version to me if they were unable to use the provided Qualtrics link for any reason. In total, 101 responses were received in the online survey and 05 responses were submitted as word documents. At nine days after the email containing the survey link was sent, 156 respondents had not responded to the survey and were sent an automatic reminder again with a Microsoft Word-document® version of the original survey tool and survey link with the same instruction.
4. Moreover, at day seven, non-respondents were called over telephone. Total, 190 non-respondents from the sampling frame were called over the next four days. Of 190 non-responsive participants, 157 received the phone call and indicated they would respond to the survey as sent in the email. However, 33 members of the non-respondents never received the phone call. Thus, in total, 131 members of the sampling frame did not participate in the survey.

The response bias was also checked in this study between original survey respondents and non- respondents of this study. The response bias was checked by conducting a phone survey with seven non-respondent members from the sampling frame (Creswell, 2014). The seven participants were selected randomly from 131 non-respondent members of sampling frame after the survey deadline had passed. The phone survey was conducted by using the same questionnaire that was provided online for the original survey respondents. The questionnaire was filled out as the participant responded to the questions and verified the entries with them.

Data Analysis

Calculating RevBT Levels Supported. Calculation of the RevBT levels supported followed the process used by Wang and Farmer (2008). The survey respondents answered six questions related to each level of RevBT. Responses were based on a six-point rating scale. The scale was always, almost always, often, seldom, almost never, and never, respectively, which was converted numerically as 5, 4, 3, 2, 1, and 0, respectively for calculating the teaching practices. Mean, SD, and range were calculated for each teaching practice and each level of RevBT for the faculty as well as by academic discipline, professional rank, and gender of the faculty members. The equation of each level of RevBT based on the questions as appeared in the survey questionnaire (Appendix E) to estimate teaching practices are presented below:

$$i. Remembering = \frac{Q1 + Q7 + Q13 + Q19 + Q25 + Q31}{6}$$

$$ii. Understanding = \frac{Q2 + Q8 + Q14 + Q20 + Q26 + Q32}{6}$$

$$iii. Applying = \frac{Q3 + Q9 + Q15 + Q21 + Q27 + Q33}{6}$$

$$iv. Analyzing = \frac{Q4 + Q10 + Q16 + Q22 + Q28 + Q34}{6}$$

$$v. Evaluating = \frac{Q6 + Q12 + Q18 + Q24 + Q30 + Q36}{6}$$

$$vi. Creating = \frac{Q5 + Q11 + Q17 + Q23 + Q29 + Q35}{6}$$

Here, Q indicates the questions as appeared in the Qualtrics with appropriate numbers.

Duncan Multiple Range Test (DMRT) was used to show the significant differences between the mean values of the six levels of RevBT and of the teaching practices within each level. DMRT was used as it showed the significant differences between mean values of each level of RevBT and as well as teaching practices within each individual level of RevBT (Allen, 2017).

Differences of Teaching Practices Based on Academic Disciplines, Professional Ranks, and Gender of Faculty Members. To explore the differences of teaching practices based on different academic disciplines, professional ranks, and gender of the faculty members, the non-parametric tests Kruskal-Wallis Test and the Mann-Whitney U Test was conducted as recommended by Glen (2016), Hecke (2012), McKnight & Najab (2010a), McKnight & Najab (2010b), Frey (2018), and Joost & Dimitra (2010). The independent variables of this study were academic disciplines, professional ranks, and gender of the faculty members. The dependent variables of this study were teaching practices related to remembering, understanding, and applying, analyzing, evaluating, and creating level of RevBT. Thus, there were six individual dependent variables for this study, including remembering, understanding, and applying, analyzing, evaluating, and creating level of RevBT.

Hecke (2012) and McKnight & Najab (2010a) recommend use of the Kruskal-Wallis Test to explore the significant differences for more than two variables for the discrete data. Thus, Kruskal-Wallis Test was conducted to explore the significant differences between academic disciplines, and professional ranks of the faculty based on teaching practices related to remembering, understanding, and applying, analyzing, evaluating, and creating level of RevBT for the RQ2. Kruskal-Wallis Test was chosen because data of this study was discrete (Glen, 2016; Hecke, 2012).

For academic disciplines, three different variables were identified (i.e., biological science, engineering science, and social science). Thus, the degrees of freedom for academic discipline were two. Moreover, for professional ranks, four different professional ranks were identified for the faculty members, which were lecturers, assistant professors, associate professors, and professors. Thus, the degree of freedom for professional rank was 3. Thus, the equation for Kruskal-Wallis Test is as follows:

Kruskal-Wallis Test (H) = $\frac{12}{n(n+1)} \times \sum \frac{R_i^2}{n_i}$ -3(n+1)

Here,

H= Test statistics

n= Total number of observations for all groups

R= Sum rank of an individual variable

i= total numbers of variables

To perform the Kruskal-Wallis Test, at first, the mean responses related to frequency with which individual faculty use specific practices for each individual level of RevBT were calculated. Then, the means of each level of RevBT of individual respondents based on academic disciplines and professional ranks were organized. Afterward, each mean value for any individual level of RevBT were ranked from lowest to highest number (Field, 2013). The smallest observation of the data received rank 1 and highest observation received rank n where n is the total number of observations in all groups. Afterwards, sum rank was calculated for an individual variable. Then, the test statistics variable was calculated and compared with the tabulated chi-square (χ^2) the degrees of freedom with the p value 0.05. For this study, there were two different degrees of freedoms for two independent variables.

For RQ2, the Mann-Whitney U Test was also used to explore the differences of the teaching practices of each level of RevBT with the gender of the faculty members as it was a pair-wise comparison. Moreover, Mann-Whitney U Test was performed to do a pair-wise comparison between academic disciplines and evaluating level of RevBT, which were found significantly different using Kruskal-Wallis Test. Like Kruskal-Wallis Test, Mann-Whitney U Test is applicable for discrete data (Frey, 2018; McKnight & Najab, 2010b; and Joost & Dimitra, 2010). For the Mann-Whitney U Test, numerical ranks were also assigned to all responses associated with teaching practices related to analyzing and evaluating of RevBT, which begins with 1 for the smallest observation and 'n' for the largest observation. Afterwards, all ranks were added up for each individual variable to calculate the Mann-Whitney U value for each variable. Mann-Whitney U Test is a two-tailed test, which means that it is used to measure both significantly greater and the significantly lower differences between two variables. After calculating the U values for each variable, lower calculated U value was used to compare with tabulated U value with the p value 0.05 as it was a 2-tailed test. The equation for Mann-Whitney U test is as follows:

$$\text{Mann-Whitney (U)} = \text{Rank Sum} - \frac{n(n+1)}{2}$$

Here,

Rank Sum= Sum of ranks for variable 1

n = Total number of observations for variable 1

Similarly, U was calculated for the second variable. Then the U value of the second variable was compared with the U value of first variable. Means of rank values were calculated and used to show the extent of differences between the compared two dependent variables.

Responses to Open-ended Questions. Three open-ended questions were asked to the survey respondents in order to identify the factors that discourage and encourage use of higher order teaching practices in class and to receive their recommendations for creating higher order teaching practices in class. The responses of these open-ended questions explored the RQ3 and RQ4. The open-ended responses were coded by using emergent coding approach (Creswell, 2013). Emergent coding approach means the concepts, actions, or meanings, which evolved during data analysis under the main code called 'advice' and supported secondary codes assist the advice (Stuckey, 2015). The main codes were put in appropriate sub-categories and categories. The primary categories of codes identified in the study included student characteristics, faculty characteristics, classroom environment, teaching resources, BAU tradition, and national and institutional benefits.

Secondary Data-Course Syllabi Analysis

Course Syllabi Collection

Syllabi of all taught courses, including compulsory, collateral, elective, and optional courses were used as secondary data sources to determine the intended teaching of the Agriculture Faculty at BAU. There are 115 courses offered at the undergraduate level at Agriculture Faculty of BAU. This includes compulsory courses, collateral elective courses, and optional courses. The Dean of the Agriculture Faculty at BAU was requested to send the course syllabi by phone. He responded by providing the course syllabi via email. The Dean of the Agriculture Faculty at BAU provided the syllabi and an authorization letter as required by Human Research Protection Program, Virginia Tech. However, course learning outcomes portion of the syllabi was used to identify the action verbs in order to determine the level of intended teaching practices.

Syllabi Data Analysis

Each action verbs were identified from the Course Learning Outcomes (CLOs) of the syllabus for further analysis process. Verb charts developed by Cullinane and Liston (2016), Shabatura (2014), and Anderson et al., 2001were used to classify the action verbs based on RevBT (Ahmed et al., 2014; Bumpus et al, 2020). Verbs not identified in my study were removed.

Some action verbs were found in the CLOs that were not in the original verb charts. For those verbs, their meaning was explored and matched with the meaning on the verb charts as recommended by Cullinane and Liston (2016), Shabatura (2014), and Anderson et al. (2001). If a new verb could potentially fit in two or more levels of RevBT, the meaning was explored critically and placed it in the best suited category. The adapted verb chart used for this study is presented in Table 3.1. The list of CLOs of all course syllabi and the categories of action verbs are provided in Appendix H. To analyze the data, the number of times the action verbs related to the specific levels of RevBT was used in each course syllabus were counted and calculate the percentages of each level of RevBT based on academic disciplines and academic years. Afterward, the findings were summarized these by academic disciplines and the academic year in which the course is taken.

Table 3.1

Adapted Action Verb Chart, which was Used to Analyze the Course Syllabi

Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
Choose	Characterize	Acquaint*	Analyze*	Assess	Compose
Clone*	Clarify	Acquire*	Calculate	Calibrate*	Construct
Define	Classify	Apply	Categorize	Compare	Design
Describe	Compare	Carry out*	Classify	Determine	Develop
Enumerate	Conceptualize*	Collect*	Compare	Estimate	Discuss
Outline	Contrast	Communicate*	Compute	Evaluate	Establish*
Recognize	Convert	Conduct*	Contrast	Explain	Explain
Relate	Deduce*	Culture*	Diagnose	Justify	Generate
Select	Demonstrate	Deliver*	Differentiate	Measure	Integrate
Show	Differentiate	Develop	Discriminate	Perceive	Modify
State*	Discuss	Draw	Distinguish	Predict	Plan
Write*	Elucidate*	Employ	Examine	Quantify*	Predict
	Explain	Execute*	Explain	Select	Prepare
	Illustrate	Extract*	Explore	Suggest*	Solve
	Interact	Face*	Isolate*		Troubleshoot*
	Interpret	Familiar*	Maintain*		
	Involve*	Formulate*	Manage		
	Narrate*	Grow*	Retrieve*		
	Outline	Identify	Separate*		
	Predict	Implement*			
	Relate	Introduce*			
	Show	Make			
	Summarize	Operate			
	Understand*	Organize			
		Perform*			
		Plan			
		Practice			
		Prepare			
		Preserve*			
		Process			
		Provide			
		Purify*			
		Raise*			
		Select			
		Sketch			
		Undertake*			
		Use			

Note. This Table is developed based on verb charts from Cullinane & Liston (2016); Shabatura, (2014); Anderson et al., (2001).

* New verbs identified during analyzing the course syllabi in the study.

Reflexivity Statement

My dissertation topic is “Exploring Teaching Practices of the Agricultural Education at Bangladesh Agricultural University (BAU).” The proposed topic is very crucial to support quality teaching at the agriculture faculty at BAU. The findings of this study will help the faculty members choose the appropriate pedagogical approaches for effective classroom teaching. Moreover, there was no previous study conducted at BAU to assess the teaching quality. Thus, I selected the proposed dissertation topic. However, I believe that the selection of my research topic was highly influenced by my previous professional and research activities, academic studies, and family orientation. I grew up in a small south-western part of Bangladesh. My mom was a primary school teacher. I saw her efforts and concerns to choose appropriate teaching methods for her students. I saw her writing lesson plans at night for her next morning class. Moreover, I was the first audience of her lesson plan before execution in her classroom. However, I rarely understood all the tools and techniques she used to teach her students. She introduced me to creative teaching and learning.

As an undergraduate student of the Agriculture Faculty of BAU, I found that most of my teachers follow a one-way lecturing for classroom teaching. Moreover, in my undergraduate classes, I rarely saw my teachers ask questions, provide individual and group assignments, or use, multi-media projectors. There was no internet access for the students and teachers in the classrooms. However, after I was appointed as a faculty member at BAU, I observed the same problems. I found that as a faculty member, I have less freedom to practice different innovative teaching strategies in the classroom due to the prescribed teaching methods. Additionally, I had a very limited lecture duration to cover a huge course content. I also found that I do not have adequate training on higher order teaching practices. Thus, I did not exactly know how I should teach my students in an effective method.

My colleagues, students, peers, friends have been complaining about the on-going teaching strategies of the Agriculture Faculty at BAU. However, there was no scientific research or investigation conducted of the Agriculture Faculty at BAU to explore the issues and realities of the teaching practices. Faculty members are the key stakeholders of the teaching practices of the Agriculture Faculty at BAU. Thus, for this study, I choose the faculty members as one of my data points. Course syllabi are the blueprints and core guidelines for the classroom instruction. Therefore, course syllabi assessment explains the quality and level of intended teaching practices. Thus, I also analyzed all of the course syllabi related to the Agriculture Faculty of BAU.

Philosophical Assumptions

Paradigms or worldviews are wider metaphysical constructs distinct from theory and are often referred to as the theoretical framework (Mertens, 2005; Mertens & Wilson, 2012). Creswell (2014) defines the worldview as a fundamental set of beliefs, which direct the action. Creswell (2014) has also described worldviews or paradigms as “a general philosophical orientation about the world and the nature of research that a researcher brings to a study” (p. 6). Worldviews of a person determine the philosophical assumption.

In social science research, ontology strongly relates to the nature of reality (Denzin & Lincoln, 2011; Tuli, 2010). Antwi and Hamza (2015) stated that ‘ontology’ is derived from two Greek words (i.e., onto and logia), which mean the origin of science, study, or theory. Wand and Weber (1993) state that ontology “is a branch of philosophy concerned with articulating the nature and structure of the world” (p. 220). Mertens and Wilson (2012) state that ontology explores the nature of reality. People experience ontology in their life as “Is there one reality that I can discover? Or are there multiple realities that differ, depending on the experience and conditions of the people in a specific context” (p. 36). Ontology helps researchers understand the question “whose reality is real?” Objectivism and constructivism are the two broad contrasting positions in ontology. Ontologically, I believe in constructivism and constructivists assume that there are multiple realities and reality is the outcome of the social process (Neuman, 2009; Antwi and Hamza, 2015). Constructivism means investigators understand and construct new knowledge from social experience (Mertens & Wilson, 2012).

O'Leary (2004) describes constructivists as "intuitive and holistic, inductive and exploratory with findings that are qualitative in nature" (pp.6-7). Research following the paradigm constructivism intends to explore 'the world of human experiences' (Mackenzie & Knipe, 2006). According to Mertens and Wilson (2012) "constructivists focus primarily on exploring multiple values and perspectives through qualitative methods" (p, 41). They believe in multiple realities and the co-creation of knowledge by researchers and respondents.

Moreover, according to Mertens and Wilson (2012), epistemology is another philosophical assumption, which explores the questions "What is the nature of knowledge and what is the relationship between the knower, and which would be known [?] (p. 6)." Denzin and Lincoln (2011) have also explained epistemology as the relationship between the researcher and participant of the research. Tuli (2010) also stated that epistemology poses the questions: "How do we know what we know? and "What counts as knowledge?" (p. 99). Epistemologically, I am a pragmatist. Pragmatists believe that knowledge is created by using different tools and types of research to utilize both inductive and deductive theories. The pragmatic paradigm focuses mainly on data found to be useful by stakeholders and utilizes mixed research methods (Mertens & Wilson, 2012). Pragmatic worldview focuses on the outcomes of the research, including actions, situations, and consequences of the inquiry, except in antecedent conditions. Pragmatic researchers focus on the problem and use multiple methods to understand the solution to the problem (Creswell, 2013; Creswell, 2014). In pragmatism, knowledge creation occurs through the pluralistic process (Creswell, 2014).

Limitations of the Study

This study only considers the cognitive process of knowledge, without considering knowledge process. Thus, this is the prime limitation of this study. Moreover, 40 action verbs in the CLOs during syllabi analysis were found, which were not listed before by Cullinane and Liston (2016), Shabatura (2014), and Anderson et al. (2001). Placement of those new verbs in the appropriate category of RevBT was subjective. Thus, this may vary from researcher to researcher and might produce different results. However, the categorization rationale and procedure would guide the future researchers to understand the process that was used in this study.

The teaching process is a highly dynamic process. It is evolving continuously and may be improved by various interventions, such as modern education, improved training, inclusion of modern teaching tools in classroom, etc. Thus, findings of this study were very much bounded by time. The findings of this study are only generalizable to faculty members of the Agriculture Faculty at BAU for July 2020.

As a researcher, I was very much connected to the survey participants and situated in the context of the case. Thus, my cognitive biases might affect the research design, data collection, analysis, and interpretation of study results. However, I choose census survey to conduct the study. Thus, this study could free from sampling bias and all members have equal opportunity to participate in the survey. Moreover, data was collected though online survey and mailed questionnaire. Therefore, I did not affect the responses of the survey participants during data collection.

Chapter 4 - Findings

This section begins with description of survey data and syllabi data used for this study. The findings and are then organized based by research questions for this study. The research questions are:

1. What is the supported cognitive level of teaching practice of the Agriculture Faculty at BAU based on RevBT (Anderson et al., 2001),
2. Does the supported cognitive level of teaching practice at BAU vary based on academic discipline, professional rank, or gender of the faculty members of the Faculty of Agriculture,
3. What discourages or encourages Agriculture Faculty at BAU from using teaching practices that support higher order cognitive levels based on RevBT (Anderson et al., 2001), and
4. What are the recommendations of the Agricultural Faculty members at BAU to create higher-order teaching practices?

Description of Survey Data and Syllabi Data

Demographics of Survey Respondents

The survey link was distributed to 237 faculty members actively teaching at the Agriculture Faculty of BAU via email. Two subsequent reminder emails were sent to the non-responsive members of the sampling frame, which also contained a Microsoft Word® version of the survey tool with the original survey link. Only 106 members of the sampling frame completed the entire survey. Incomplete survey responses were discarded from further analysis. Using the responses from the 106 faculty members provided a 44.73 percent response rate.

Moreover, response bias was checked in the survey responses. The results of the Mann-Whitney U Test to determine response bias were: (U) = 247 and $p = 0.410$ ($p \geq 0.05$). This result shows that the value of p is greater than .05. This indicates that there is no significant difference between responses from the respondents and non-respondents. Thus, the survey findings are free from response bias. Moreover, Cronbach's alpha (α) for the final survey responses was calculated in order to report the internal consistency among the responses. The Cronbach's alpha (α) value for the final survey responses was 0.923. This means there was high internal consistency among the responses.

Most of the members of the sampling frame (68.37%) belonged to the biological science discipline. This was followed by social science (19.41%) and engineering science (12.24%) disciplines, respectively (Table 4.1). Similarly, among the final survey respondents, most of the participants (70.75%) were faculty members in the biological science disciplines. This is followed by social science (21.70%), and engineering science (7.55%) disciplines, respectively. Faculty members of the biological science disciplines were slightly over-represented in the total survey respondents by 2.38%. This was followed by social science disciplines that were over-represented in the total survey respondents by 2.29%. However, faculty members from the engineering science disciplines were marginally underrepresented in the total survey participants by 4.69% (Table 4.1).

Table 4.1

Demographics of Survey Respondents based on Academic Disciplines

Individual group	Total participants of sampling frame (N=237)	Responded participants (n=106)	Percentage of sampling frame of individual group	Percentage of responded participants
Biological science	162	75	68.37	70.75
Engineering science	29	8	12.24	7.55
Social science	46	23	19.41	21.70

In terms of professional rank, most of the faculty members of the sampling frame were professors (59.92%). This was followed by assistant professors (15.61%), associate professors (13.50%), and lecturers (10.97%), respectively (Table 4.2). Similarly, most of the survey respondents were professors (57.55%). This was followed by associate professors (16.04%), assistant professors (15.09%), and lecturers (11.32%), respectively. Of the survey respondents, associate professors, and lecturers were marginally over-represented in the total survey respondents by 2.57% and 0.35%, respectively. However, professors and assistant professors of the sampling frame were very slightly underrepresented in the total survey respondents by 2.37% and 0.52%, respectively (Table 4.2).

Table 4.2

Demographics of Survey Respondents based on Professional Ranks

Individual group	Potential participants of sampling frame (N=237)	Responded participants (n=106)	Percentage of sampling frame of individual group	Percentage of responded participants
Professor	142	61	59.92	57.55
Associate Professor	32	17	13.50	16.04
Assistant Professor	37	16	15.61	15.09
Lecturer	26	12	10.97	11.32

Most of the faculty members of the sampling frame were male (74.26%). Similarly, more male faculty members (78.30%) responded to the survey. However, only 25.74% members of the sampling frame are female faculty members. Of all the survey respondents, 21.70% are female survey respondents of the sampling frame. From the sampling frame, female faculty members over marginally represented in the total survey participants by 4.04%. While female faculty members are slightly underrepresented from the sampling frame by 4.04% (Table 4.3).

Table 4.3

Demographics of Survey Respondents based on Gender of Faculty Members

Individual group	Total participants of sampling frame (N=237)	Responded participants (n=106)	Percentage of sampling frame of individual group	Percentage of responded participants
Female	61	23	25.74	21.70
Male	176	83	74.26	78.30

Moreover, the gender distribution of the survey respondents based on academic disciplines and professional ranks are presented in Table 4.4 and table 4.5, respectively. Data shows that in all three academic disciplines, most of the survey respondents are male faculty members. Similarly, most of the members of the sampling frame are male faculty members. However, of these academic disciplines, the biological science disciplines have the most female respondents (16), which is followed by social science disciplines (6), and engineering science Disciplines (1), respectively.

Table 4.4

Gender Distribution of Survey Respondents Based on Academic Discipline, n= 106

Individual group		**Total participants of sampling frame (N=237)**	**Responded participants (n=106)**	**Percentage of sampling frame of individual group**	**Percentage of responded participants**
Female	Biological Science	38	16	16.03	15.09
	Engineering Science	2	01	0.84	0.94
	Social Science	14	06	5.91	5.66
Male	Biological Science	122	59	51.48	55.66
	Engineering Science	30	07	12.66	6.60
	Social Science	29	17	12.24	16.04

Like academic disciplines, a greater number of male faculty members responded to the survey from all academic ranks (Table 4.5). Of all the female survey respondents, the highest number (08) of female survey respondents were lecturers and assistant professors. This was followed by professors (05) and associate professors (02), respectively.

Table 4.5

Gender Distribution of Survey Respondents Based on Professional Ranks, n= 106

	Individual group	Total participants of sampling frame (N=237)	Responded participants (n=106)	Percentage of sampling frame of individual group	Percentage of responded participants
Female	Lecturer	14	08	5.91	7.55
	Assistant Professor	12	08	5.06	7.55
	Associate Professor	10	02	4.22	1.89
	Professor	18	05	7.59	4.72
Male	Lecturer	12	04	5.06	3.77
	Assistant Professor	25	08	10.55	7.55
	Associate Professor	22	15	9.28	14.15
	Professor	124	56	52.32	52.83

Description of Syllabi Data

The characteristics of the course syllabi are presented in Table 4.6. There are 115 courses providing 150 credit hours of instruction offered by the Agriculture Faculty of BAU to fulfill the requirement of the degree B.Sc. Ag. (Hons.). Of these 115 courses, 66.96% are theory courses and 33.04% are practical courses. In the Agriculture Faculty of BAU, theory courses are recitation based and practical courses are laboratory based. Biological science offers most of the courses provided by the college. This is followed by social science and engineering science, respectively. Undergraduate students have to take 36 compulsory theory courses, along with 36 practical courses. The students must also take four elective theory courses.

In freshman year and sophomore year, the Faculty of Agriculture offers almost an equal number of theory and practical courses. However, in the junior and senior year, most of the offered courses are theory courses (28) compared to the practical courses. Moreover, a large number of elective theory courses are offered during their junior and senior years.

Table 4.6

Summary of Courses of the Agriculture Faculty at Bangladesh Agricultural University

Parameters	Theory Course		Practical or Laboratory Field based Course	
	N	%	n	%
Overall courses distribution	77	66.96	38	33.04
Academic Disciplines				
Biological science	66	57.39	32	27.83
Engineering science	03	2.61	02	1.74
Social science	08	6.96	04	3.48
Academic Years				
Freshman Year	11	9.57	10 (1)	8.70
Sophomore Year	10	8.70	09	7.83
Junior Year	28 (18)	24.34	10	8.70
Senior year	28 (19)	24.34	09	7.83

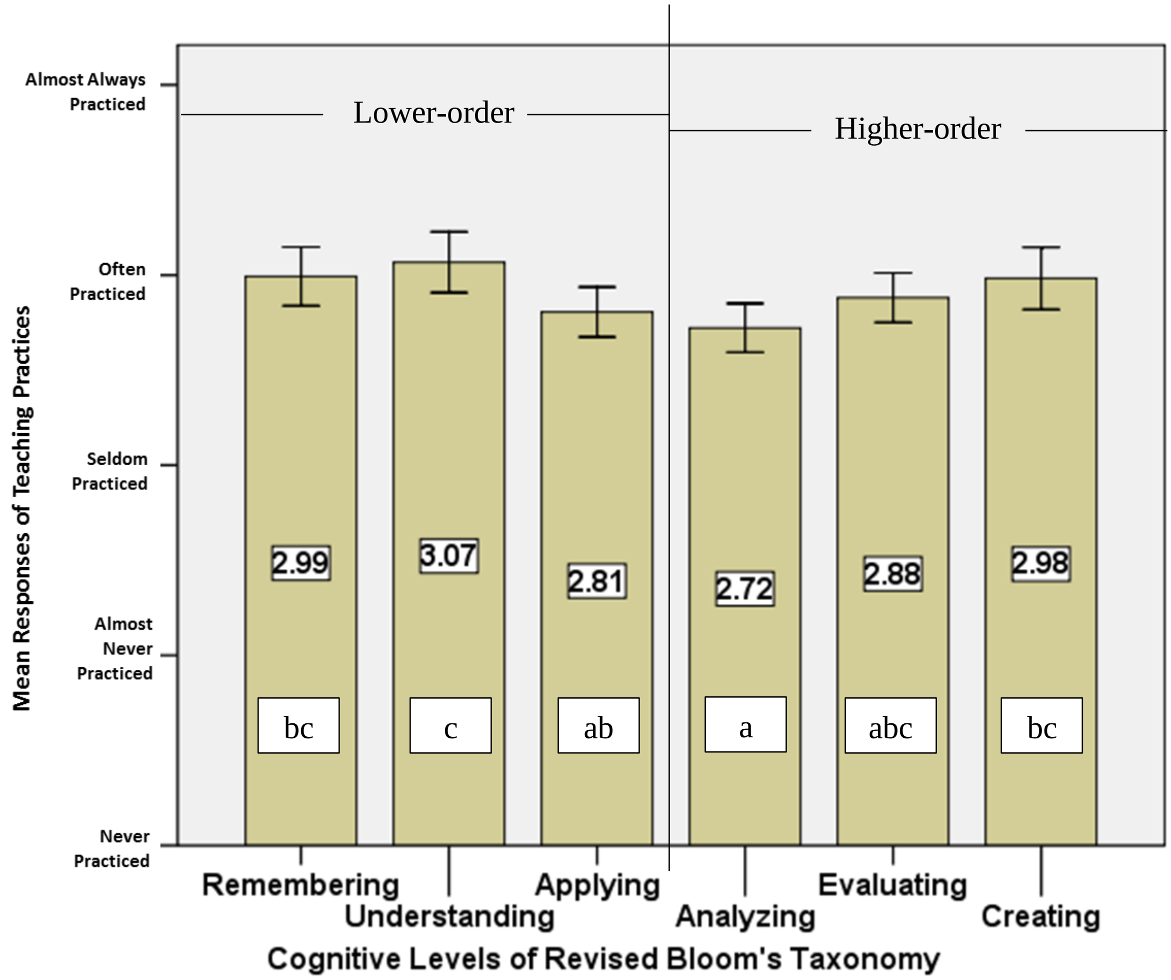
Research Question 1- What is the supported cognitive level of teaching practice of the Agriculture Faculty at BAU based on Revised Bloom's Taxonomy (Anderson et al., 2001)?

Survey Findings

Teaching Practices Based on Levels of RevBT. Overall distribution of the teaching practices according to different cognitive levels of RevBT is presented in Figure 4-1. Based on the findings, faculty use remembering, understanding, and creating practices slightly, although statistically significantly, more often (p=.010) than analyzing. Faculty members also use understanding significantly more often than applying level (p=.010). Despite the slight significant differences across the levels, the means for all cognitive levels of RevBT are close to 3, which correspond with the response, "often." This finding suggests faculty members report using teaching practice from all cognitive levels of RevBT **often** for their classroom instruction.

Figure 4-1

Distribution of Teaching Practices Faculty Report Using Different Cognitive Levels of Revised Bloom's Taxonomy (RevBT), n = 106



Note. Error Bars show standard error at 95% confidence of intervals.

a-c within bars indicates significant difference.

F-ratio = 3.037**.

$p \leq 0.01$.

Remembering. The basic or lowest cognitive level of RevBT is remembering. This level is considered as a lower order teaching practice. At this level faculty members encourage students to define, memorize, repeat, name, recall, or label a concept. Average value of responses related to frequency with which faculty use these specific practices for remembering are presented in Table 4.7. Based on the findings, faculty members use teaching practices that allow students to define and recall the concepts in classes significantly slightly more often (p =.005) than the teaching practices that allow students to memorize and label concepts in classes. Regardless of the significant mild differences, the average values of all teaching practices at remembering are close to 3, which correspond with the response, "often." This suggests faculty members report using each practice of remembering level often for their classroom instruction.

Table 4.7

Mean, Standard Deviation, and Range Based on Faculty Responses Related to Use of Specific Teaching Practices with the Remembering Level of Revised Bloom's Taxonomy, n = 106

Teaching Practices	Average	Range	F-ratio	p
I allow students to define concepts in my class	$3.27(1.35)_b$	1-5		
I allow students to memorize concepts in my class	$2.72(1.45)_a$	0-5		
I allow students to repeat concepts in my class	$2.99(1.21)_{ab}$	1-5	3.353**	.005
I allow students to name concepts in my class	$3.00(1.29)_{ab}$	0-5		
I allow students to recall concepts in my class	$3.22(1.34)_b$	0-5		
I allow students to label concepts in my class	$2.75(1.05)_a$	1-5		

Note. Standard deviations are provided in parentheses.

a-b indicate significant difference.

**p is significant at 99% level of confidence.

Values assigned to participant's responses to calculate means: 0 = Never practiced, 1 = Almost Never Practiced, 2 = Seldom Practiced, 3 = Often Practiced, 4 = Almost Always Practiced, and 5 = Always Practiced.

Understanding. Understanding is the cognitive level above remembering, of RevBT, and is also known as a lower order teaching practice. The faculty members encourage students to describe, discuss, explain, identify, recognize, and locate concrete concepts in classes at the understanding level. The average of the responses related to the frequency with which the faculty report using these specific practices are presented in Table 4.8. The faculty members report having students describe concepts significantly marginally more often, but having students locate concepts ($p = .039$). Despite the minor significant differences, the average values of all teaching practices at remembering are close to 3 which corresponds with the response, "often," who means faculty members report using each practice of understanding level **often** for their classroom education.

Table 4.8

Mean, Standard Deviation, and Range Calculated Based on Faculty Responses Related to Use of Specific Teaching Practices with the Understanding Level of Revised Bloom's Taxonomy, n = 106

Teaching Practices	Average	Range	F-ratio	p
I encourage students to describe concrete concepts in my class	3.28(1.31)$_b$	1-5	1.507*	.039
I encourage students to discuss concrete concepts in my class	3.12(1.20)$_{ab}$	2-5		
I encourage students to explain concrete concepts in my class	3.09(1.19)$_{ab}$	2-5		
I encourage students to identify concrete concepts in my class	3.03(1.22)$_{ab}$	0-5		
I encourage students to recognize concrete concepts in my class	3.03(1.20)$_{ab}$	1-5		
I encourage students to locate concrete concepts in my class	2.85(1.00)$_a$	1-5		

Note. Standard deviations are provided in parentheses.

a-b indicate significant difference.

*p is significant at 95% level of confidence.

Values assigned to participant's responses to calculate means: 0 = Never practiced, 1 = Almost Never Practiced, 2 = Seldom Practiced, 3 = Often Practiced, 4 = Almost Always Practiced, and 5 = Always Practiced.

Applying. Applying is the cognitive level above understanding, of RevBT, and is also known as a lower order teaching practice. At the applying level of RevBT, faculty members help students learn to apply, demonstrate, translate, manipulate, practice, and illustrate their knowledge. The average of the responses related to the frequency with which the faculty report using these specific practices are presented in Table 4.9. Of these teaching practices, faculty members use teaching practices that encourage students to apply rules and principles in classes significantly more often than other teaching practices at this level ($p = .000$). The average value of the responses of this teaching practice is close to 3.0, which means faculty members significantly more **often** use all these teaching practices for their classroom instruction. Results also show that teaching practices that require to manipulating rules and principles are significantly the least used practices by the faculty ($p = .000$). The teaching practice that requires manipulating rules and principles is **seldom** used by the faculty members as the mean value is close to 2.00. However, at this level, teaching practices related to demonstrate, practice, and translate rules and principles in classes are also used **often** by the faculty members as the mean values of responses related to these responses are close to 3.00.

Table 4.9

Mean, Standard Deviation, and Range Calculated Based on Faculty Responses Related to Use of Specific Teaching Practices with the Applying Level of Revised Bloom's Taxonomy, n = 106

Teaching Practices	Mean	Range	F-ratio	p
I help students apply rules and principles in my class	3.42(1.34)$_c$	2-5	14.820***	.000
I help students demonstrate rules and principles in my class	2.99(1.11)$_b$	1-5		
I help students translate rules and principles in my class	2.68(1.03)$_b$	0-5		
I help students manipulate rules and principles in my class	2.10(1.29)$_a$	0-5		
I help students practice rules and principles in my class	2.91(1.09)$_b$	2-5		
I help students illustrate rules and principles in my class	2.74(1.02)$_b$	1-5		

Note. Standard deviations are provided in parentheses.

a-c indicates significant difference.

***p is significant at 99.99% level of confidence.

Values assigned to participant's responses to calculate means: 0 = Never practiced, 1 = Almost Never Practiced, 2 = Seldom Practiced, 3 = Often Practiced, 4 = Almost Always Practiced, and 5 = Always Practiced.

Analyzing. Analyzing is the cognitive level above applying, of RevBT and considered to be the higher order teaching practices. At this level, faculty members select the teaching practices, which encourage the students learn to distinguish, differentiate, compare, contrast, critique, and examine between different constructs. The average of the responses related to the frequency with which the faculty report using these specific practices are presented in Table 4.10. Result shows that faculty members use teaching practices that support to distinguish, differentiate, and critique rules and principles in classes significantly more often than the teaching practices that let students compare, contrast, and examine rules and principles in classes (p = .003). Of these six teaching practices, the average of the responses related to the frequency of teaching practices related to distinguish, differentiate, and critique rules and principles in classes are close to 3.00, which indicate that these practices are used **often** by the faculty members for classroom teaching. Whereas the average of the responses related the responses of the teaching practices for comparing, contrasting, and examining rules and principles in classes are close to 2.00, which indicates that these practices are used **seldom** by the faculty members.

Table 4.10

Mean, Standard Deviation, and Range Calculated Based on Faculty Responses Related to Use of Specific Teaching Practices with the Analyzing Level of Revised Bloom's Taxonomy, n = 106

Teaching Practices	Mean	Range	F-ratio	p
I let students distinguish rules and principles in my class	3.01(1.18)$_{c}$	1-5	3.613**	.003
I let students differentiate rules and principles in my class	2.81(1.08)$_{bc}$	1-5		
I let students compare rules and principles in my class	2.66(0.93)$_{ab}$	1-5		
I let students contrast rules and principles in my class	2.42(1.00)$_{a}$	0-5		
I let students critique rules and principles in my class	2.73(1.05)$_{abc}$	0-5		
I let students examine rules and principles in my class	2.70(0.96)$_{ab}$	1-5		

Note. Standard deviations are provided in parentheses.

a-c indicates significant difference.

**p is significant at 99% level of confidence.

Values assigned to participant's responses to calculate means: 0 = Never practiced, 1 = Almost Never Practiced, 2 = Seldom Practiced, 3 = Often Practiced, 4 = Almost Always Practiced, and 5 = Always Practiced.

Evaluating. Evaluating is the cognitive level above analyzing, of RevBT and also considered to be one of the higher order teaching practices. Teaching practices at this level encourage students learn to evaluate, rate, judge, justify, summarize, and appraise the cognitive strategies. The average of the responses related to the frequency with which the faculty report using these specific practices are presented in Table 4.11. Faculty selected teaching practices, which create conditions within which students evaluate their cognitive strategy is significantly slightly more used than other teaching practices at the evaluating level (p = .000). Despite this slight significant difference, the average of the responses related to the frequency for all these teaching practices at the evaluating level are almost 3.00, which indicate that faculty members **often** create conditions within which students evaluate, rate, judge, justify, summarize, and apprize their cognitive strategies to their new knowledge.

Table 4.11

Mean, Standard Deviation, and Range Calculated Based on Faculty Responses Related to Use of Specific Teaching Practices with the Evaluating Level of Revised Bloom's Taxonomy, n = 106

Teaching Practices	Mean	Range	F-ratio	p
I create conditions within which students evaluate their cognitive strategy	$3.35(1.35)_b$	1-5	5.188***	0.000
I create conditions within which students rate their cognitive strategy	$2.82(0.97)_a$	2-5		
I create conditions within which students judge their cognitive strategy	$2.75(0.92)_a$	1-5		
I create conditions within which students justify their cognitive strategy	$2.79(1.02)_a$	0-5		
I create conditions within which students summarize their cognitive strategy	$2.81(0.98)_a$	1-5		
I create conditions within which students appraise their cognitive strategy	$2.76(0.97)_a$	0-5		

Note. Standard deviations are provided in parentheses.

a-b indicate significant difference.

***p is significant at 99.99% level of confidence.

Values assigned to participant's responses to calculate means: 0 = Never practiced, 1 = Almost Never Practiced, 2 = Seldom Practiced, 3 = Often Practiced, 4 = Almost Always Practiced, and 5 = Always Practiced

Creating. The uppermost cognitive level of RevBT is creating. This higher order teaching level encourages students learn to plan, propose, design, arrange, organize, and modify different problem-solving approaches. The average of responses related to frequency with which faculty use these specific practices for creating are presented in Table 4.12. At this level, no significant differences are found between the average responses related to the frequency which faculty use these specific practices for creating level of RevBT (p = .085). The average values of all teaching practices at creating are close to 3, which correspond with the response, "often." This suggests faculty members **often** use all these teaching practices for their classroom instruction.

Table 4.12

Mean, Standard Deviation, and Range Calculated Based on Faculty Responses Related to Use of Specific Teaching Practices with the Creating Level of Revised Bloom's Taxonomy, n = 106

Teaching Practices	Mean	Range	F-ratio	p
I plan activities that will encourage students to plan problem solving in my class	2.88(1.08)	2-5		
I plan activities that will encourage students to propose problem solving in my class	3.29(1.29)	1-5		
I plan activities that will encourage students to design problem solving in my class	3.00(1.20)	2-5	1.943	.085
I plan activities that will encourage students to arrange problem solving in my class	2.99(1.31)	0-5		
I plan activities that will encourage students to organize problem solving in my class	2.88(1.17)	2-5		

Teaching Practices	Mean	Range	F-ratio	p
I plan activities that will encourage students to modify problem solving in my class	2.86(1.18)	1-5		

Note. Standard deviations are provided in parentheses.

a-b indicate significant difference.

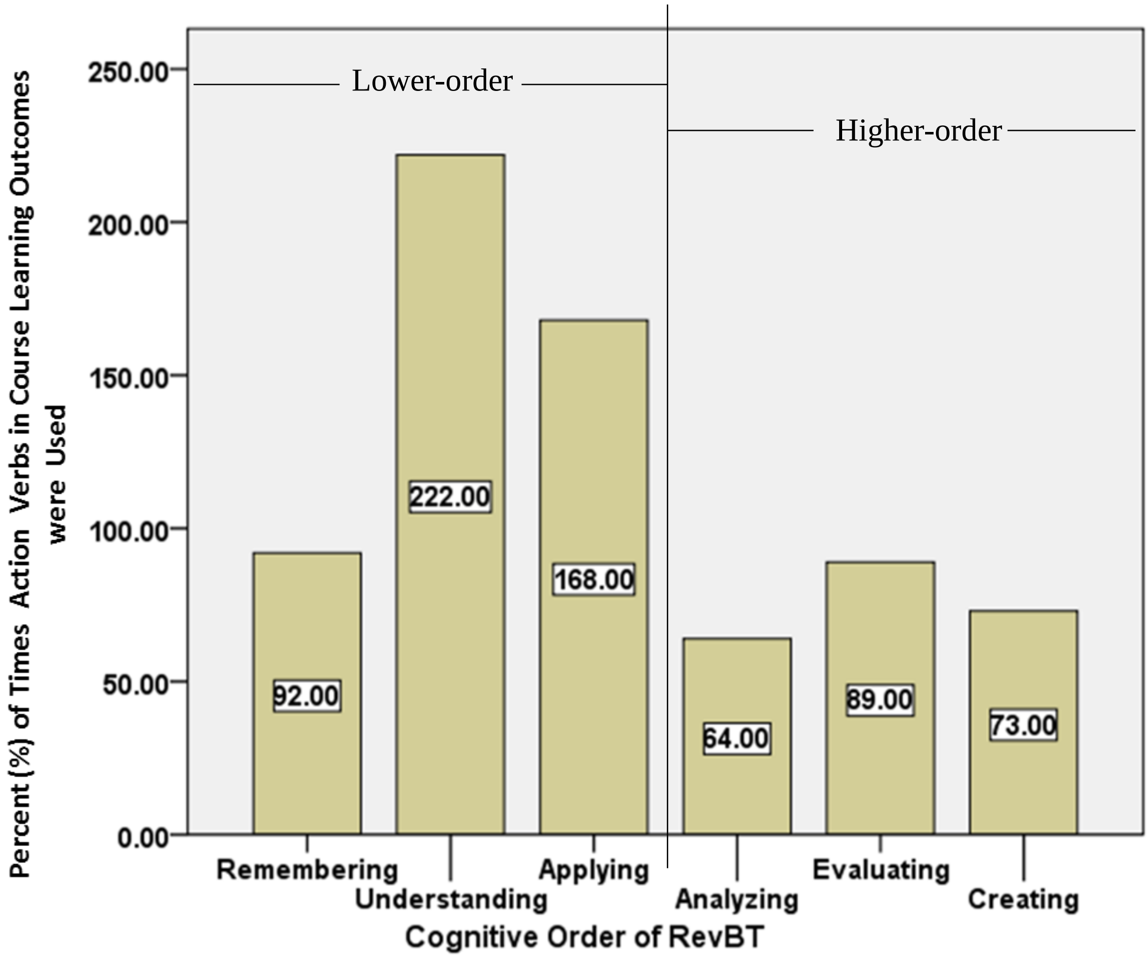
Participant's response code used to calculate mean: 0 = Never practiced, 1 = Almost Never Practiced, 2 = Seldom Practiced, 3 = Often Practiced, 4 = Almost Always Practiced, and 5 = Always Practiced.

Findings from Secondary Data

Action verbs associated with the cognitive levels of RevBT are presented in Figure 4-2. Action verbs associated with lower order teaching practices were used with greater frequency (482 times) in CLOs than those associated with higher order teaching practices (226 times). Of the six levels of RevBT, action verbs associated with the understanding level were used with higher frequency (222 times) than were action verbs associated with other levels of RevBT. This is followed by the applying (168 times), remembering (92 times), evaluating (89 times), creating (73 times), and analyzing (64 times) level of RevBT. This figure also indicates that the CLOs of all courses of the Agriculture Faculty at BAU mainly emphasize on the understanding level of RevBT. However, analyzing is the least emphasized level of RevBT of all the cognitive levels in the course syllabi.

Figure 4-2

Action Verbs found in the Course Syllabi of the Agriculture Faculty at BAU Based on Each Cognitive Level of Revised Bloom's Taxonomy, N= 561



Note. Here, N is the number of Course Learning Outcomes.

Total number of course syllabi = 115.

Syllabi Supported Category of Action Verbs Based on Academic Disciplines. I analyzed 115 course syllabi for this study, which contained 693 unique CLOs. In each CLO, the minimum number of action verb was one (e.g., **Explain** the concept, functions, sources and management of plant nutrients). The maximum number of action verbs was four. A screenshot of a syllabus with the CLOs and action verbs is shown in Figure 4-3. In an individual CLO, there may be one or more action verbs. I only counted the action verbs and calculated the percentages.

Figure 4-3

Sample of A Syllabus Showing Organization of Action Verbs in Course Learning Outcomes

Course Learning Outcomes (CLOs)

CLO 1.	Describe the basic concept of ICTs and e-extension along with its importance, scope and limitations, perceive the role of ICTs in extension work, and explore the current e-extension platforms in Bangladesh
CLO 2.	Conceptualize fundamental issues of web 2.0; describe the benefits and use of web 2.0 tool; and conceptualize the internet ethics and security; develop basic understanding about the design of basic web page and portfolio
CLO 3.	Develop the understanding of the need and scope of social media in extension service; perceive the principle of social media and risk in it; explore the current initiatives in social media and conceptualize the critical issues of existing content
CLO 4.	Undertake appropriate initiatives to develop the capacity to create content for Facebook and YouTube through mini action research

Note. Underlined words are the action verbs.

The action verbs of the CLOs found in the course syllabi separated by academic discipline are presented in Figure 4-4. Action verbs associated at the understanding level were used more frequently (32.29%) than at the other levels of RevBT for the courses of biological science, which is followed by applying (24.13%), evaluating (14.16%), and remembering (13.29%) level of RevBT. However, 8.57% action verbs associate with analyzing and creating level of RevBT were found in courses related to biological science.

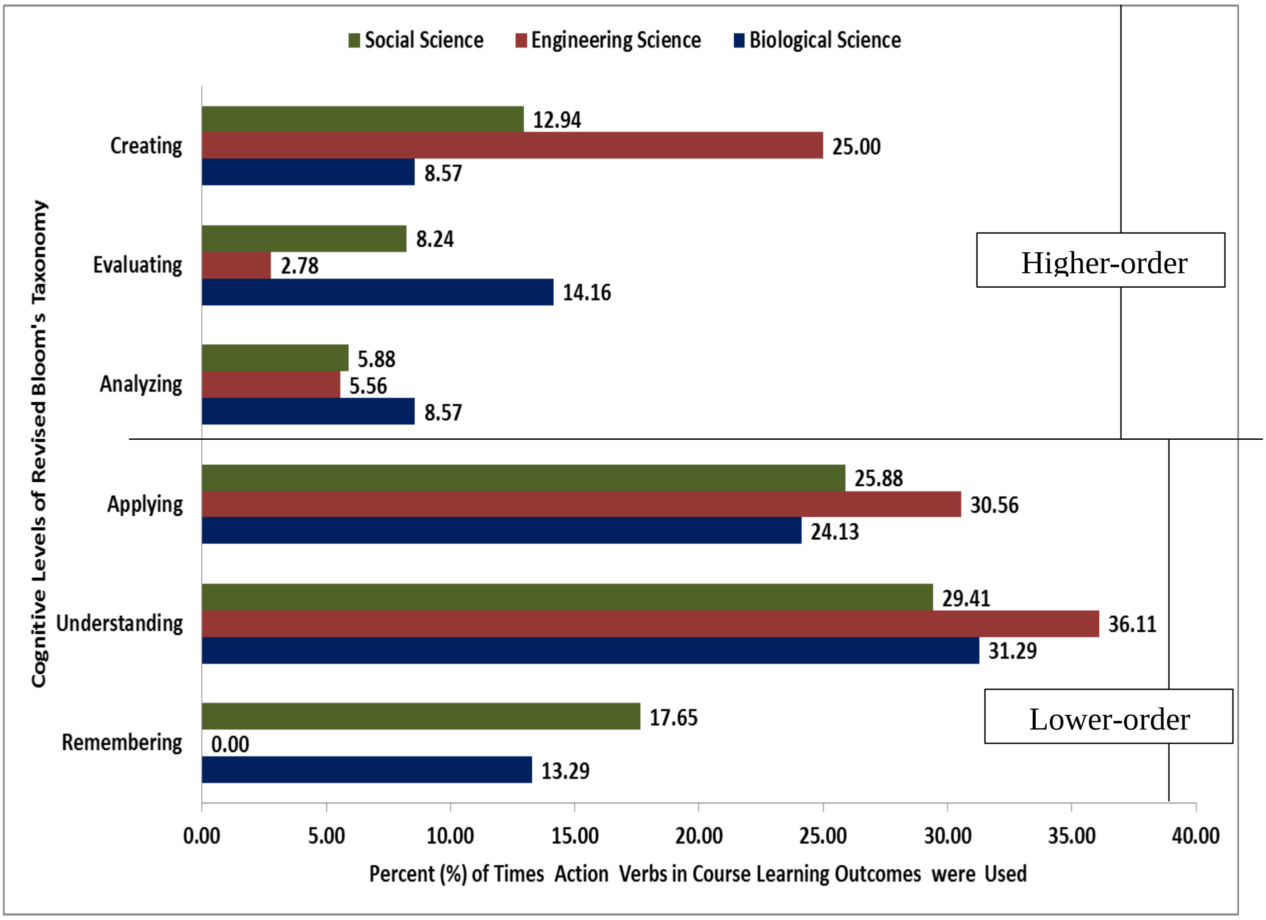
In engineering science, action verbs related with the understanding level were also used more frequently (36.11%). This was followed by the applying (30.56%), creating 25.00%s), analyzing (5.56%), and evaluating (2.78%) levels, respectively. However, no action verbs from the understanding level were reported in any course syllabi in engineering science.

Social science follows a similar trend as the engineering science. In this discipline, action verbs associated with understanding level were also used with higher percentages

(29.41%). This is followed by applying (25.88%), remembering (17.65%), creating (12.94%), evaluating (8.24%), and analyzing (5.88%) level of RevBT.

Figure 4-4

Level of All Action Verbs identified in 693 Course Learning Outcomes from 115 Course Syllabi Classified by Academic Discipline of the Agriculture Faculty at BAU



Note. Total number of CLOs from the courses of biological science were 572, total number of CLOs from the courses of engineering scince were 36, and total number of CLOs from the courses of social science were 85.

Syllabi Supported Category of Action Verbs by Academic Years. The action verbs of the CLOs found in the course syllabi separated by the academic year in which a course is provided are presented in Figure 4-5. Action verbs associated with applying level were used with higher percentages (32.50%) in all course syllabi related to freshmen year. This was followed by understanding (29.17%), remembering (15.83%), creating (9.17%), evaluating (8.33%), and analyzing (5.00%) levels of RevBT.

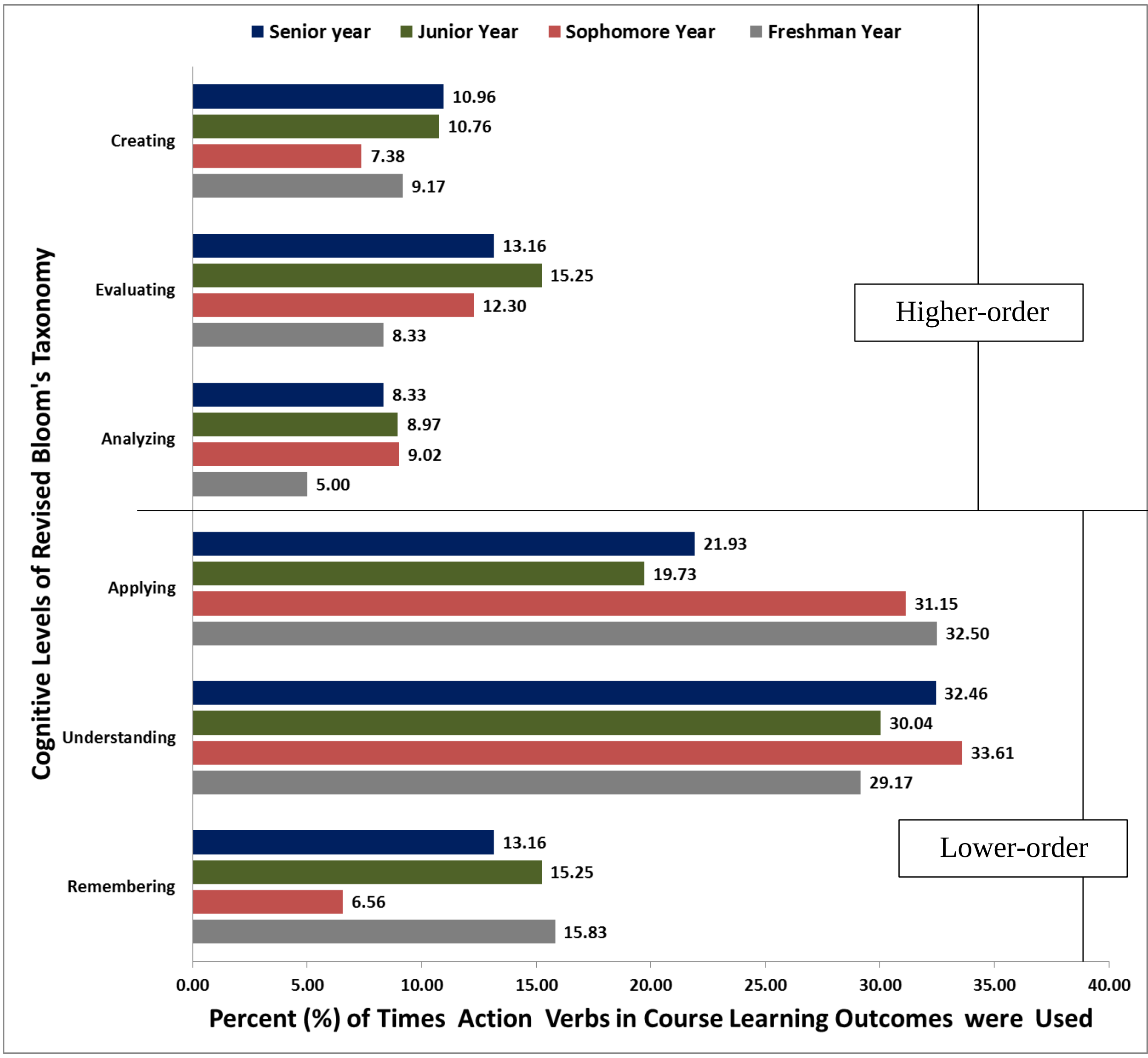
In sophomore year, the highest percentages of action verbs used in the CLOs were associated with the understanding level (33.61%). This was followed by applying (31.15%), evaluating (12.30%), analyzing (9.02%), creating (7.38%), and remembering (6.56%) levels of RevBT.

In the junior year, a higher percentage of action verbs used in CLOs are also observed for understanding level (30.04%) that is followed by applying level (19.73%). Action verbs associated with remembering and evaluating level were used 15.25% in all course syllabi in junior year. This is followed by creating (10.76%) and analyzing level (8.97%).

In the senior year, like the other three academic years, the higher used percentages of action verbs of CLOs are associated with the understanding level of RevBT (32.46%). The applying level follows at 21.93%. Action verbs associated with remembering and evaluating level were used 13.16% in all course syllabi in senior year. This is followed by the creating (10.96%) and analyzing (8.33%) levels of RevBT.

Figure 4-5

Level of All Action Verbs identified in 561 Course Learning Outcomes from 115 Course Syllabi Classified by Academic Year of the Agriculture Faculty at BAU



Note. Total number of CLOs from the courses of freshmen year were 120, total number of CLOs from the courses of sophomore year were 122, total number of CLOs from the courses of junior year were 223, and total number of CLOs from the courses of senior year were 228.

Research Question 2- Does the supported cognitive level of teaching practice at BAU vary based on academic discipline, professional rank, or gender of the faculty members of the Faculty of Agriculture?

BAU Faculty Teaching Practices Based on Academic Disciplines.

Biological Science. The average of responses related to frequency with which faculty use the teaching practices associated with the specific levels of RevBT for biological science discipline are presented in Table 4.13. For biological science, the average of responses related to the frequency which faculty use for analyzing level is significantly slightly lower than the average response related to the frequency of teaching practices related to the remembering, understanding, evaluating, and creating levels of RevBT (p = .038). This means in this academic discipline, the slightly more used teaching practices relate to the remembering, understanding, applying, evaluating, and creating level of RevBT. Despite the minor significant differences, average of response related to the frequency which faculty use for teaching practices associated with all cognitive levels of RevBT for biological science are close to 3, which correspond with the response, “often.” This suggests faculty members, on average, reported using all cognitive levels of RevBT often for their classroom instruction.

Table 4.13

Faculty Responses Related to the Use of Specific Teaching Practices for Individual Level of Revised Bloom’s Taxonomy of Biological Science, n = 75

Cognitive levels	Average	Range	F-ratio	p
Remembering	2.97(0.80) $_b$	1.67-5.00	2.38*	.038
Understanding	3.00(0.77)$_b$	2.00-5.00		
Applying	2.83(0.71)$_{ab}$	1.33-5.00		
Analyzing	2.68(0.68)$_a$	1.17-5.00		
Evaluating	2.94(0.65)$_b$	1.67-5.00		
Creating	3.04(0.87)$_b$	2.00-5.00		

Note. Standard deviations are provided in parentheses.

a-b indicate significant difference.

*p is significant at 95% level of confidence.

Values assigned to participant's responses to calculate means: 0 = Never practiced, 1 = Almost Never Practiced, 2 = Seldom Practiced, 3 = Often Practiced, 4 = Almost Always Practiced, and 5 = Always Practiced.

Engineering Science The average of responses related to the frequency with which faculty use the teaching practices associated with the RevBT levels for engineering science discipline are presented in Table 4.14. No significant differences were found (p = 0.954). The average of the responses related to the frequency with which faculty use teaching practices associated with all cognitive levels of RevBT for engineering science were close to 3, which corresponds with the response, "often." This suggests faculty members **often** use all cognitive levels of RevBT for their classroom instruction.

Table 4.14

Faculty Responses Related to the Use of Specific Teaching Practices for Individual Level of Revised Bloom's Taxonomy of Engineering Science, n = 08

Cognitive levels	Average	Range	F-ratio	p
Remembering	3.10(0.71)	2.17-4.00	0.22	.954
Understanding	3.35(1.14)	2.00-5.00		
Applying	3.00(0.95)	1.83-4.50		
Analyzing	3.02(0.68)	2.17-4.00		
Evaluating	3.17(0.76)	2.00-4.67		
Creating	3.29(0.93)	2.33-4.50		

Note. Standard deviations are provided in parentheses.

Values assigned to participant's responses to calculate means: 0 = Never practiced, 1 = Almost Never Practiced, 2 = Seldom Practiced, 3 = Often Practiced, 4 = Almost Always Practiced, and 5 = Always Practiced.

Social Science. The average of responses related to the frequency with which faculty use the teaching practices associated with the RevBT levels for social science discipline are presented in Table 4.15. In the social science, average of responses related to the frequency which faculty use for the teaching practices related to the applying, evaluating, and creating levels of RevBT are significantly slightly lower than those related to the understanding level of RevBT (p = .037). This finding also indicates that faculty members of these academic disciplines choose marginally more teaching practices related to the understanding level. However, the average of the responses related to the frequency with which faculty use teaching practices associated with all cognitive levels of RevBT for social science were close to 3, which corresponds with the response, “often.” This suggests faculty members **often** use all cognitive levels of RevBT for their classroom instruction. faculty members **often** use all cognitive levels of RevBT for their classroom instruction.

Table 4.15

Faculty Responses Related to the Use of Specific Teaching Practices for Individual Level of Revised Bloom’s Taxonomy of Social Science, n = 23

Cognitive levels	Mean	Range	F-Ratio	p
Remembering	3.03(0.87)ab	1.67-4.50	2.45*	.037
Understanding	3.20(0.90)b	2.17-5.00		
Applying	2.67(0.45)a	2.00-3.67		
Analyzing	2.77(0.60)ab	2.00-4.17		
Evaluating	2.60(0.67)a	2.00-4.33		
Creating	2.70(0.69)a	2.00-5.00		

Note. Standard deviations are provided in parentheses.

a-b indicates significant difference.

*p is significant at 95% level of confidence.

Values assigned to participant’s responses to calculate means: 0 = Never practiced, 1 = Almost Never Practiced, 2 = Seldom Practiced, 3 = Often Practiced, 4 = Almost Always Practiced, and 5 = Always Practiced.

Differences between Use of Levels of Revised Bloom’s Taxonomy by Academic Discipline. Kruskal-Wallis Test was conducted to explore the differences between use of levels of RevBT by academic disciplines are presented in Table 4.16. Findings showed that only the teaching practices related to the evaluating level of RevBT were significantly differently used in the different academic disciplines (p = 0.016). Engineering science has a higher mean rank than the biological science and social science for the evaluating level of RevBT.

Table 4.16

Kruskal-Wallis Test Calculated Differences between Use of Levels of Revised Bloom's Taxonomy by Academic Discipline, n = 106

Academic Disciplines	Mean Rank	χ^2	*p*
Remembering			
Biological science	52.55		
Engineering science	58.12	0.311	0.856
Social science	55		
Understanding			
Biological science	51.68		
Engineering science	60.25	0.971	0.615
Social science	57.09		
Applying			
Biological science	54.28		
Engineering science	58	0.638	0.727
Social science	49.39		
Analyzing			
Biological science	51.02		
Engineering science	67.06	2.353	0.308
Social science	56.87		
Evaluating			
Biological science	56.98		
Engineering science	65.69	8.222*	0.016
Social science	37.91		
Creating			
Biological science	55.42		
Engineering science	64.5	3.825	0.148
Social science	43.41		

Note. *p ≤ .05 (95% level of confidence)

However, in order to measure the extent of differences between the academic disciplines for the evaluating level of RevBT, the Mann-Whitney U Test was conducted. The results of Mann-Whitney U Test are presented in Table 4.17. This shows that no significant differences have been found between the mean rank values of the teaching practices for the evaluating level of RevBT for biological science with engineering science (p = 0.410). However, significant differences have been found between the mean rank value of biological science with social science (p = 0.008). The mean rank value for social science for the evaluating level of RevBT is also significantly lower than engineering science (p = 0.043). However, the mean rank value for engineering science is higher than the other two disciplines.

Table 4.17

Mann-Whitney U Test Calculated Differences Between Use of Evaluating Level Revised Bloom's Taxonomy by Academic Disciplines, n = 106

Academic Disciplines	Mean Rank	*Mann-Whitney U*	*p*
Evaluating			
Biological sciences	41.92	247.00	0.410
Engineering science	48.62		
Evaluating			
Biological sciences	53.69	584.50**	0.008
Social science	35.85		
Evaluating			
Engineering science	21.56	47.50*	0.043
Social science	14.07		

Note. *p ≤ .05 (95% level of confidence); **P ≤ .01 (99% level of confidence)

BAU Faculty Teaching Practices Based on Professional Ranks

Lecturers. The average of responses related to frequency with which lecturers use the teaching practices are presented in Table 4.18. For lecturers, no significant differences were found (p = 0.171). However, the higher average value is observed for the remembering level. Whereas, the lowest average value is observed for the analyzing level of RevBT. Moreover, the average of response related to the frequency which faculty use for teaching practices associated to the remembering, understanding, evaluating, applying, and creating levels of RevBT as mean values of these levels are close to 3.00.

Table 4.18

Faculty Responses Related to the Use of Specific Teaching Practices for Individual Level of Revised Bloom's Taxonomy of Lecturers, n = 12

Cognitive levels	Average	Range	F-Ratio	p
Remembering	3.10(0.91)	1.67-4.50	1.604	0.171
Understanding	2.88(0.61)	2.17-4.00		
Applying	2.56(0.47)	2.00-3.50		
Analyzing	2.43(0.49)	1.33-3.00		
Evaluating	2.86(0.64)	2.00-4.50		
Creating	2.69(0.74)	2.00-4.50		

Note. Standard deviations are provided in parentheses.

Values assigned to participant's responses to calculate means: 0 = Never practiced, 1 = Almost Never Practiced, 2 = Seldom Practiced, 3 = Often Practiced, 4 = Almost Always Practiced, and 5 = Always Practiced.

Assistant Professors. The average of responses related to frequency with which assistant professors use the teaching practices are presented in Table 4.19. No significant differences were found (p = 0.737). However, for assistant professors, the highest average value of the teaching practices is found at the understanding level. This is followed by the evaluating, creating, remembering, applying, and analyzing levels of RevBT, respectively. The average of responses related to the frequency which assistant professors use for teaching practices also indicate that they **often** use teaching practices related to all cognitive levels of RevBT as average values of these levels are close to 3.00.

Table 4.19

Faculty Responses Related to the Use of Specific Teaching Practices for Individual Level of Revised Bloom's Taxonomy of Assistant Professors, n =16

Cognitive levels	Mean	Range	F-Ratio	p
Remembering	2.77(0.62)	1.67-3.83	0.552	0.737
Understanding	2.96(0.75)	2.00-4.50		
Applying	2.66(0.82)	1.33-4.00		
Analyzing	2.61(0.63)	1.17-3.83		
Evaluating	2.94(0.84)	1.67-5.00		
Creating	2.89(1.00)	2.17-5.00		

Note. Standard deviations are provided in parentheses.

Values assigned to participant's responses to calculate means: 0 = Never practiced, 1 = Almost Never Practiced, 2 = Seldom Practiced, 3 = Often Practiced, 4 = Almost Always Practiced, and 5 = Always Practiced.

Associate Professors. The average of responses related to frequency with which associate professors use the teaching practices are presented in Table 4.20. Like lecturers, and assistant professors, no significant differences were found for the associate professors (p = 0.473). However, the most used teaching practices for the associate professors based on the average of responses are related to the remembering level of RevBT, which is followed by the understanding, creating, applying, evaluating, and analyzing levels of RevBT, respectively. The average of responses related to frequency with which associate professors use the teaching practices also indicate that associate professors **often** use teaching practices from all cognitive levels of RevBT as average values are close to 3.00.

Table 4.20

Faculty Responses Related to the Use of Specific Teaching Practices for Individual Level of Revised Bloom's Taxonomy of Associate Professors, n =17

Cognitive levels	Mean	Range	F-Ratio	p
Remembering	3.25(0.80)	2.00-4.67	0. 918	0.473
Understanding	3.16(0.83)	2.00-4.50		
Applying	2.96(0.69)	2.17-4.50		
Analyzing	2.80(0.75)	2.00-4.50		
Evaluating	2.82(0.75)	2.00-5.00		
Creating	3.02(0.73)	2.00-5.00		

Note. Standard deviations are provided in parentheses.

Values assigned to participant's responses to calculate means: 0 = Never practiced, 1 = Almost Never Practiced, 2 = Seldom Practiced, 3 = Often Practiced, 4 = Almost Always Practiced, and 5 = Always Practiced.

Professors. The average of responses related to frequency with which professors use the teaching practices are presented in Table 4.21. Like the other three professional ranks, no significant difference was found (p = .155). Professors' most preferred teaching practices relate to the understanding level of RevBT. This is followed by the creating, remembering, evaluating, applying, and creating levels of RevBT, respectively. The average values also indicate that professors **often** use teaching practices from all cognitive levels of RevBT as mean values of these levels are close to 3.00.

Table 4.21

Faculty Responses Related to the Use of Specific Teaching Practices for Individual Level of Revised Bloom's Taxonomy of Professors, n =61

Cognitive levels	Mean Responses	Range	F-Ratio	p
Remembering	2.96(0.82)	1.67-5.00	1.614	0.155
Understanding	3.11(0.90)	2.00-5.00		
Applying	2.85(0.67)	2.00-5.00		
Analyzing	2.78(0.67)	1.83-5.00		
Evaluating	2.89(0.63)	2.00-5.00		
Creating	3.05(0.86)	2.00-5.00		

Note. Standard deviations are provided in parentheses.

Values assigned to participant's responses to calculate means: 0 = Never practiced, 1 = Almost Never Practiced, 2 = Seldom Practiced, 3 = Often Practiced, 4 = Almost Always Practiced, and 5 = Always Practiced.

Differences between Use of Levels of Revised Bloom's Taxonomy by Professional Ranks. Results from Kruskal-Wallis Test show the differences of the teaching practices of the faculty members based on professional ranks are presented in Table 4.22. Findings from the Kruskal-Wallis Test show that none of the cognitive levels of RevBT are significantly varied based on professional ranks of the faculty members ($p \geq 0.05$).

Table 4.22

Kruskal-Wallis Test Calculated Differences between Use of Levels of Revised Bloom's Taxonomy by Professional Ranks, n = 106

Professional Ranks (N= 106)	**Mean Rank**	χ^2	***p***
Remembering			
Lecturer	57.38		
Assistant Professor	46.16	2.773	0.428
Associate Professor	62.44		
Professors	51.46		
Understanding			
Lecturer	47.46		
Assistant Professor	51.41	0.926	0.819
Associate Professor	58.00		
Professors	53.98		
Applying			
Lecturer	42.33		
Assistant Professor	44.78	4.356	0.226
Associate Professor	61.29		
Professors	55.81		
Analyzing			
Lecturer	42.67		
Assistant Professor	53.28	1.798	0.615
Associate Professor	53.88		
Professors	55.58		
Evaluating			
Lecturer	54.46		
Assistant Professor	51.47	0.793	0.851
Associate Professor	48.26		
Professors	55.30		
Creating			
Lecturer	40.46		
Assistant Professor	47.84	3.722	0.293
Associate Professor	59.32		
Professors	55.93		

Note. $p \leq .05$ (95% level of confidence)

BAU Faculty Teaching Practices Based on Gender of Faculty Members.

Female Faculty Members. The average of responses related to frequency with which female faculty use the teaching practices are presented in Table 4.23. No significant difference was found between the average of responses related to frequency with which female faculty members use the teaching practices for the different cognitive levels of RevBT (p = .416). However, remembering and understanding show highest average of responses of reported teaching practices. This is followed by the creating, evaluating, applying, and analyzing levels of RevBT, respectively. Female faculty members **often** use all cognitive levels of RevBT as the averages of responses are close to 3.00.

Table 4.23

Faculty Responses Related to the Use of Specific Teaching Practices for Individual Level of Revised Bloom's Taxonomy of Female Faculty Members, n =23

Cognitive levels	Average	Range	F-Ratio	p
Remembering	2.83(0.67)	1.67-4.50	1.00	0.42
Understanding	2.83(0.54)	2.17-4.00		
Applying	2.67(0.59)	1.33-4.00		
Analyzing	2.45(0.42)	1.17-3.00		
Evaluating	2.70(0.56)	1.67-5.00		
Creating	2.80(0.82)	2.00-4.50		

Note. Standard deviations are provided in parentheses.

Values assigned to participant's responses to calculate means: 0 = Never practiced, 1 = Almost Never Practiced, 2 = Seldom Practiced, 3 = Often Practiced, 4 = Almost Always Practiced, and 5 = Always Practiced.

Male Faculty Members. The average of responses related to frequency with which male faculty use the teaching practices are presented in Table 4.24. Like female faculty members, no significant differences were found between the average of responses related to frequency with which male faculty members use the teaching practices for the different cognitive levels of RevBT (p = .103). Averages of responses of the reported teaching practices indicate that male faculty members' most used teaching practices are connected with the understanding level of RevBT. This is followed by the creating, remembering, evaluating, applying, and analyzing levels, respectively. The average of responses also indicate that male faculty members **often** use teaching practices from all cognitive levels of RevBT as average values of these levels are close to 3.00.

Table 4.24

Faculty Responses Related to the Use of Specific Teaching Practices for Individual Level of Revised Bloom's Taxonomy of Male Faculty Members, n =83

Cognitive levels	Mean	Range	F-Ratio	p
Remembering	2.99(0.82)	1.67-5.00	1.84	0.10
Understanding	3.13(0.89)	2.00-5.00		
Applying	2.87(0.70)	1.83-5.00		
Analyzing	2.81(0.69)	1.83-5.00		
Evaluating	2.93(0.71)	2.00-5.00		
Creating	3.04(0.86)	2.00-5.00		

Note. Standard deviations are provided in parentheses.

Values assigned to participant's responses to calculate means: 0 = Never practiced, 1 = Almost Never Practiced, 2 = Seldom Practiced, 3 = Often Practiced, 4 = Almost Always Practiced, and 5 = Always Practiced.

Differences between Use of Levels of Revised Bloom's Taxonomy by Gender of the Faculty Members. Mann-Whitney U Test shows the variation of the teaching practices of the faculty members based on gender of the faculty members are presented in Table 4.25. Among the six cognitive level of RevBT, analyzing level is only significantly varied based on gender of faculty members (p = 0.023). Findings show that female faculty members significantly report using less teaching practices that relate with the analyzing level of RevBT than male faculty members (p = 0.023). Mean rank value of the teaching practices is higher for male faculty members for each level of RevBT, except at the remembering level. Mean rank values of the teaching practices for all cognitive levels of RevBT are also higher for male faculty members compared to female faculty members, except at the remembering level (Table 4.24).

Table 4.25

Mann-Whitney U Test Calculated Differences between Use of Levels of Revised Bloom's Taxonomy by Gender of the Faculty Members, n= 106

Professional Ranks	Mean Rank	Mann-Whitney U	*p*
Remembering			
Female faculty members	54.78	925.00	0.820
Male faculty members	53.14		
Understanding			
Female faculty members	46.61	796.00	0.222
Male faculty members	55.41		
Applying			
Female faculty members	44.41	745.00	0.107
Male faculty members	56.02		
Analyzing			
Female faculty members	40.70	660.00*	0.023
Male faculty members	57.05		
Evaluating			
Female faculty members	46.13	785.00	0.191
Male faculty members	55.54		
Creating			
Female faculty members	46.59	795.50	0.2221
Male faculty members	55.42		

Note. *$p \leq .05$ (95% level of confidence)

Research Question 3- What discourages or encourages Agriculture Faculty at BAU from using teaching practices that support higher order cognitive levels based on Revised Bloom's Taxonomy (Anderson et al., 2001)?

Factors which Discourage Use of Higher Order Teaching Practices in Classrooms

Faculty members identified 195 factors, which discourage them from using higher order teaching practices. These limiting factors are listed in Appendix I. Moreover, the categories of the discouraging factors, which prevent the faculty members from using the higher order teaching practices in classrooms, are presented in Table 4.26.

Table 4.26

Categories and Subcategories of the Discouraging Factors for Using Higher Order Teaching Practices, Total Number of Responses= 201, Total Number of Survey Respondents= 106.

Categories	Associated subcategories
Student characteristics	1. More interested in job preparation. 2. Lack of motivation in classroom studies. 3. Lack of time for self-study. 4. Faulty job examination system.
Faculty characteristics	1. Lack of training. 2. More involvement in additional activities. 3. Lack of incentives. 4. Unreadiness to follow higher order teaching practices. 5. Lack of freedom to follow higher order teaching practices.
Classroom environment	1. Inappropriate classroom environment. 2. Huge number of students per class. 3. Classrooms are not well-furnished and well equipped. 4. Limited lecture sessions.
Teaching resources	1. Lack of modern teaching aids and facilities. 2. Lack of appropriate class materials.
BAU Tradition	1. Rigid curriculum for classroom teaching and evaluation system. 2. The nature of the subject or courses. 3. Limited semester duration. 4. Lack of community motivation. 5. Political constraints. 6. Low students- teacher ratio.

Student Characteristics. The most cited discouraging factor for adopting higher order teaching practices identified by the respondents is student characteristics. Students possess various characteristics, which discourage faculties to use higher order teaching practices in classrooms. These factors include lack of agricultural subject-based job market for graduates, lack of students' mind set to adopt higher order teaching practices, lack of attentiveness of students during lecture sessions, lack of willingness to read scientific articles and textbooks, and students' expectation to finish the huge course contents by one-way lecturing methods. Most of the respondents stated that students are more interested in getting a better job after their graduation than classroom learning. One survey respondent replied, "Students are demotivated due to job scarcity in the relevant field that makes them reluctant to learn." Moreover, survey respondents also believe that students are more comfortable with the traditional teaching-learning practices than higher order teaching practices. Therefore, they are not willing to start higher order teaching practices. One respondent indicates that "Sometimes it is very much difficult to start new thing against a continuous process. Most of the students like to learn through the lower- order process. As a result, they think higher order teaching process as a complex one" Faculty members also stated that most of the students are not willing to read scientific articles and advanced textbooks as reading materials and plagiarize from open-source internet materials. One survey respondent reported that "Students are not willing to read manuscript and book related to topic and only they want to copy and paste from Internet when I provide them assignment."

Faulty students' job recruitment examination system also restricts faculty members to use higher order teaching practices in classrooms. Faculty members have claimed that the nature of the job recruitment examination system has forced students to emphasize on recruitment examination preparation. Moreover, there are some discriminations has been observed between different jobs. Agriculture officers do not enjoy similar facilities like administration officers. Thus, students do not put their attention on a subject matter related job and are instead looking for a better administration, police, customs, and tax related government job. One survey respondent reported that

> "Challenges in motivating the students to learn and respond to higher order teaching practices. It is far more difficult than the first challenge because all the public exams for job recruitment requires plenty of memorizing. Students spend much more time to prepare for those public exams during the 4 years of graduation at universities and are not interested to gain in-depth disciplinary knowledge."

Faculty members also stated that they see students are only focused on job preparation for a secured future life. They also mentioned that students also need a certificate and degree to get such jobs. Thus, they are highly focused on job-related preparation. One survey respondent reported that "Student's class performance or semester results/points do not make many differences as to whether they will get a job or not. They better pay attention to preparation for the job even in the beginning of the under-graduation classes."

Faculty Characteristics. Besides student characteristics, faculty characteristics is also important limiting factor that discourages to use higher order teaching practices in classrooms. Of these faculty characteristics, lack of training on higher order teaching practices is most cited by the survey respondent as a discouraging factor. Faculty members have identified that they need a quality and standard training program on higher order teaching practices. Then they can apply those strategies for classroom teaching. One survey respondent reported as "We do not have enough facilities (especially technical facilities, lack of training, etc.)." Moreover, most of the faculty members are not habituated with the higher order teaching practices in classrooms. Faculty members also lack adequate leadership to implement higher order teaching practices. Faculty politics is also another important limiting factor that restrict faculty members to use higher order teaching practices in classrooms.

Furthermore, senior faculty members are not interested to practice higher order teaching practices in classrooms. Senior faculty members are not also interested to set higher order exam questions to assess the learning outcomes for the students. Moreover, faculty members have no freedom to practice any innovative teaching practices, which are not listed in the syllabi. They must follow the recommended teaching practices. One survey respondent replied that "A teacher has no freedom to practice higher order teaching practices. He/she has to follow the rules and process, determined by the authority."

Classroom Environment. Inappropriate classroom environment is also another important category to use higher order teaching practices in class. Faculty members mentioned different reasons, which imbalance effective classroom environment. These reasons include small classroom area, noisy environment, sound-echo, lack of chairs and tables, classroom seating arrangement, inadequate laboratory facilities, and advanced laboratory equipment. One survey respondent clearly mentioned that “[We have] basic technological problem, e.g. sound system problems, multimedia projector deficit in practical classroom.”

Moreover, faculty members also identified that most of classes are over-loaded with large number of students. Faculty members state that both theory and practical classes have more students than expected. Physical classroom size is too small to accommodate such large numbers of students. One survey respondent reported as “The size of the class is too big to contact, monitor and taking feed-back both in the theoretical and practical classes.” Thus, the scope of group discussions, personal contact, feedback, class monitoring, and problem-solving activities are limited for the faculty members.

Moreover, the lecture sessions are very short to practice higher order teaching practices in classrooms. The duration for theory and practical classes for the Agriculture Faculty at BAU is 55 minutes and 120 minutes, respectively. Faculty members mentioned that they are more concerned to finish the syllabus contents with this limited time. This situation restricts them to provide group-based projects and brainstorming sessions for the students. They also have limited time for feedback and question answering sessions for students during class period. Therefore, they are not able to practice higher order teaching practices in limited and intensive lecture sessions. One survey respondent reported as “The time constraints of class and tightly packed semester schedule leave small room for more higher order teaching practices.”

Teaching Resources. Lack of modern teaching resources is another important discouraging factor that restrict faculty members to use higher order teaching practices in classrooms. Faculty members identified that they have lack modern teaching audio, visuals, and audio-visuals teaching aids. such as multimedia projectors and other technological limitations. Standard and quality teaching materials are not available for the faculty members.

One survey respondent reported as “Sometimes, it is very difficult to find appropriate class materials to that matches the content of topic and can take hours and hour.” Moreover, faculty members have no access to many peer-reviewed scientific journals. Thus, they cannot include the updated scientific knowledge in their class notes.

BAU Tradition. The next discouraging factor that restrict faculty members to use higher order teaching practices in classrooms is tradition of BAU. The current curriculum, evaluation system, and nature of courses do not promote higher order teaching practices. Faculty members identified that the current evaluation system of BAU only allows closed-book exams. Moreover, the examination system is also not consistent to support higher order teaching. The survey respondents also said that the course content is also dated. Moreover, all courses have to be conducted by a single teacher and there is no teaching assistant for the faculty members. Therefore, a single teacher struggles a lot to practice higher order teaching practices as stated by the survey respondents. One survey respondent reported that

> “Our Undergraduate education systems do not have enough room (single class teacher) to apply the higher order practices; however, in MSc level I can practice it partially. I mean no scope (BSc) for assignment, plenary discussion, recent publication discussion, open ended questions, etc.”

Moreover, BAU has limited semester duration with many pre-defined off days and circumstantial off days. One survey respondent reported that “The time constraints of class and tightly packed semester schedule leave small room for more higher order teaching practices.” Besides these issues, faculty members also mentioned that political pressure, socio-economic constraints also restrict them to use higher order teaching practices in classrooms.

Factors which Encourage Faculty Members to Use Higher Order Teaching Practices in Classrooms

Faculty members of the Agriculture Faculty of BAU identified 162 encouraging factors, which inspire them to use higher order teaching practices. These are listed in

Appendix J. Moreover, the categories of the encouraging factors, which help the faculty members to use the higher order teaching practices in classrooms, are presented in Table 4.27.

Table 4.27

Categories and Subcategories of the Encouraging Factors for Using Higher Order Teaching Practices, Total Number of Responses= 161, Total Number of Survey Respondents= 106.

Categories	Associated subcategories
Student characteristics	1. Improves creativity and critical thinking abilities. 2. Improves real world problem-solving skills. 3. Improves attentiveness and understanding. 4. Improves leadership skills. 5. Increases education and learning effectiveness.
Faculty characteristics	1. Increases teaching efficiency.
Classroom environment	2. Creates better classroom environment. 3. Saves lecture times. 4. Helps to maintain the semester schedule. 5. Helps students to get up-to-date information in classroom.
National and institutional benefits	1. Helps to create quality graduates. 2. Helps to national growth. 3. Overall education and research will be advanced.

Students Characteristics. The most encouraging factor to use higher order teaching practices in classroom is that higher order teaching practices have positive impacts on students' characteristics. Faculty members have mentioned that students can think independently and solve problems by themselves with critical thinking abilities. One survey respondent said that "Students can make critical interpretations, draw relevant and insightful conclusions using their own background knowledge." Faculty members also assume that higher order teaching practices can enhance analytical skills and classroom engagement for the students. Survey respondents also mentioned that students can design and implement any program effectively with creative thinking abilities, which help the graduates to have a better job-placement after their graduation.

Faculty members stated that higher order teaching practices enhance students' problem-solving skills. Students can solve real-life problems, which is the resultant of effective teaching and learning. They found that students can adopt systematic methods to solve a complex problem. Moreover, survey respondents also stated that students can be more confident in solving any unseen problems as well. One survey respondent said that “It helps the student to improve their thinking and problem-solving ability by critically analyzing complex problems or situations.”

Survey respondents also stated that due to use higher order teaching practices, teachers can explain and present the subject matter in a clearer way, which is helpful for the students. Thus, higher order teaching practices help to builds in-depth understanding capacities for students. Survey respondents assumed that students can connect the subject matter with their previous knowledge. Thus, it reduces the dependency on the memorizing skills of students. One survey respondent said that “Using more higher order teaching practices help the students understanding higher levels of the facts, infer them, and connect them to other concepts rather than just memorizing.” Faculty members also stated that higher order teaching practices improve the analyzing skills of students. Due to better analyzing abilities, students can better assess the situation and respond accordingly. One survey respondent said that “Students can apply the knowledge they acquired, analyze, and evaluate what they know.”

Moreover, faculty members stated that higher teaching order is more engaging, and students get more interested in learning. They also stated that higher order teaching practices increase students’ interest and attention to the classes. One survey responded stated that “Students are happy to learn in the class. They say they do not need to more study at room, they are enjoyed students centered learning.” Higher order teaching practices also enhance student’s confidence level. One survey respondent said that “Students become confident in solving unseen problem, which would be more effective for being competitive graduates.”

Teachers Characteristics. Higher order teaching practices have also positive effect on faculty characteristics. Faculty members stated that an effective teaching and learning increases students' knowledge level. Moreover, survey respondents also stated that teachers can provide quality and standard education to their students. Faculty members also found that effective teaching and learning also improves the interaction between students and teachers. Teachers may share better reading materials to students, which improves the overall knowledge retention for the students. Faculty members also stated that effective teaching and learning reduces the time for lecture sessions. Thus, teachers can deliver effective lectures to students. One survey respondent said that "The teachers will also be dynamic in gathering knowledge from updated literature and sharing the knowledge to the students. This will ultimately help improving the learning environment"

Higher order teaching practices allow teachers to identify the students who needs mentoring and plan accordingly. Teachers can also get feed-back of delivering courses and teaching strategies. Moreover, teachers can cover more areas of the syllabus. One survey respondent stated that "It will increase the efficiency of teaching learning process by increasing the involvement of both teachers and students in the knowledge flow." Moreover, survey respondents mentioned that higher order teaching practices also make their classes more communicative and livelier. Moreover, higher order teaching practices also guide the faculty members toward effective teaching method selection. One survey respondent mentioned that "It provides me with the better understanding of how I should carry my teaching methods in favor of students."

Classroom Environment. The next important encouraging factor that encourages faculty members to use higher order teaching practices in classroom is congenial classroom environment. Higher order teaching practices enhance congenial and cooperative classroom environment for both students and faculty members. Thus, it creates better teaching and learning environment for the students. Moreover, faculty members also mentioned that higher order teaching practices is time saving and allow the faculty members to maintain the semester schedule. One survey respondent mentioned that “The classroom environment will be good both for teachers and students [due to use higher order teaching practices].”

National and Institutional Benefits. The next encouraging factor that inspires faculty members to use the higher order teaching practices in classroom is national and institutional benefit. Faculty members stated that higher order teaching practices can produce better competitive graduates and scale up the university ranking. One faculty member responded that “Higher competencies of the students in the global industry. Students will be more qualified to compete. Finally, our university will be topper in world ranking.”

Moreover, faculty members also believed that higher order teaching practices is also important for national growth. One survey respondent stated that “Without using more higher order teaching practices tertiary education is meaningless. National growth in education sector will be practically impossible. At the same time, research area will not be competitive in the global market. Finally, national growth may be unsustainable.”

Research Question 4- What are the Recommendations of the Agricultural Faculty Members at BAU to Create Higher Order Teaching Practices?

This section illustrates the answer for research question four: What are the recommendations of the Agricultural Faculty members at BAU to create higher order teaching practices. Data obtained through open-ended question are also used to develop this section. Faculty members have suggested 186 recommendations to create higher order teaching practices, which are listed in Appendix K. Moreover, the categories of the recommendations of the Agriculture Faculty members at BAU to create higher order teaching practices in classrooms are presented in Table 4.28.

Table 4.28

Categories and Subcategories of the Recommendations to Create Higher Order Teaching Practices, Total Number of Responses= 186, Total Number of Survey Respondents= 106.

Categories	Associated subcategories
Faculty characteristics	1. Include more group-based assignment, presentation, reading assignments, demonstration, hands-on practical works, and field trips. 2. Arrange advanced training programs. 3. Creates more congenial atmosphere in classrooms. 4. Ensure accountability. 5. Follow recommend textbooks and provide class notes. 6. Follow Bloom's Taxonomy in classrooms. 7. Change mentality of teachers.
BAU Tradition	1. Assessment method should be improved. 2. Course curricula and syllabi should be revised. 3. Change job-exam system. 4. Reduce overall political pressure. 5. Implement students counselling system to improve mental health. 6. Monitoring and evaluation for teaching and evaluation approaches 7. Enhance students' facilities in all stages. 8. Implement student-based teachers' evaluation system. 9. Assure dignity of the meritorious students. 10. Provide more incentives for teachers.
Classroom environment	1. Reduce number of students per class. 2. Classroom should be well furnished and decorated with modern equipment. 3. Make congenial classroom environment. 4. Introduce cooling system. 5. Lecture period needs to be re-scheduled. 6. Increase teacher student ratio.
Teaching resources	1. Include digital learning management systems. 2. Provide available teaching resources. 3. Provide financial supports to develop new teaching materials. 4. Provide teaching and research assistantship.
Student characteristics	1. Rules and regulations about students' behavior and discipline should be updated. 2. Change students' mind-set.

Faculty Characteristics. Most of the survey respondents recommended to transform the faculty characteristics to create higher order teaching practices in classrooms. Faculty members of BAU stated that they have very limited knowledge on higher order teaching practices. Thus, the faculty members suggested to provide adequate training on higher order teaching practices. One survey respondent suggested that "Proper need-based training and workshops for the faculty members to inspire them to use higher order teaching practices more effectively."

Faculty members recommended that the authority should motivate the faculty members to use Bloom's Taxonomy in classroom teaching. One survey respondent recommended that "We can follow Bloom's taxonomy to promote higher order thinking." Introducing teaching assessment system is also mentioned by survey respondents to create higher order teaching practices at BAU. Faculty members mentioned that there is no teaching evaluation system at BAU. Thus, they recommended a proper monitoring and assessment system for the classroom teaching at BAU in order to assure the higher order teaching practices. One survey respondent recommended that "Introducing teaching assessment." Faculty members also recommended that teachers should include presentation, group study, brain storming, and field visit in their teaching process. Moreover, teachers should follow more research-based activities to select their teaching methods. Moreover, survey respondents also complained that faculty members should be more attentive to their academic activities instead of outside activities. They should provide more scientific articles, textbooks, and innovative reading materials to their students. One survey respondent replied that "Classroom based teaching should be improved which should include more group approaches and problem-solving assignment/tasks to replace/reduce number of exams."

Moreover, student centered teaching and learning approaches should be implemented at BAU. Faculty member suggested that students should be encouraged to participate in more group-based learning approaches such as brainstorming, group discussions, and group presentations for both theory and practical classes. Survey respondents also recommended that group-based learning should be developed based on real-world problems. One survey respondent recommended that "Presentation, group study, brain storming, field travelling should be practiced and materialized in all the departments of Agriculture faculty."

BAU Tradition. Most of the survey respondents recommended to change the traditional teaching learning system of BAU. Faculty members recommended including more group-based classroom assignments, which should originate from real life problems. One survey respondent recommended that “Classroom based teaching should be improved which should include more group approaches and problem-solving assignment/tasks to replace/reduce number of exams.” Faculty members have also recommended revising the assessment system, including more quiz test, surprise exam, elevating minimum pass marks, etc. One survey respondent recommended that “Pass marks should be 50% (and below 80% marks in a specific subject will lead students to attend the exam once again).” Faculty members also recommended including more open-ended critical questions to assess learning outcomes too. Moreover, the survey respondents also recommended to develop job market-oriented curriculum for the students. Moreover, the faculty member wanted more freedom in classrooms to develop their own syllabi contents. Survey respondents also recommended to reduce the course loads for the students. Faculty members recommended that course content should be reduced in order to create higher order teaching practices. One survey respondent recommended that “Course contents should be reduced judicially, only few basics with more applied topics should be added.”

Moreover, better subject-matter oriented job placement should be assured to create higher order teaching practices. Faculty members recommended that job assurance and subject-matter oriented job placement will help students to pay more attention to their classes. One survey respondent recommended that “Request to the national level policy makers to emphasize on the subject matter knowledge while recruiting for the job.”

Classroom Environment. Faculty members also recommended many suggestions to improve the classroom environment in order to create higher order teaching practices. Faculty members suggested to optimize the number of students per class in order to conduct classes more effectively. Faculty members have recommended that theory classes should have 40 to 60 students and practical classes should have 20 students. One survey respondent suggested that "Number of students per class should not be more than 50 in theory classes and 20 in practical classes."

Faculty members also recommended to renovate classrooms, which includes modern equipment, furniture, etc. for both theory and practical classes. Faculty members also recommend installing air conditioning units in classrooms instead of noisy electric fans. They firmly believed that sound and congenial classroom environment is critical to creating higher order teaching practices at BAU. One survey respondent suggested that "Create good environment (no noise of fan) or try to accommodate air condition in the classroom." They have also recommended allocating modern laboratory equipment and facilities to create higher order teaching practices in practical classrooms.

Teaching Resources. Faculty members also recommended to improve teaching resources at BAU to create higher order teaching practices. These included modern teaching instrument, reading materials, etc. Faculty members recommended to provide proper classroom equipment in classes to assure higher order teaching in the classroom. One survey respondent stated that "Better facilities of teaching instruments in the classroom and equipment in the labs [should be provided]." Faculty members also recommended to introduce digital platform for teachers and student's interaction. Moreover, faculty members recommended to introduce graduate assistant system for BAU. One faculty member recommended that "Provide teaching and research assistantship for post-graduate students."

Student Characteristics. Only a few faculty members recommended to transform students' characteristics. Faculty members recommend introducing more disciplinary regulations to control students' behavior. Moreover, faculty members also believed that students should understand the importance of higher order teaching practices to get a better job. One faculty member mentioned that “First make the students understand that they need to learn something in their courses to get a good job through making the job market more competitive not by color or other means but by merit.”

Chapter 5 - Discussion and Conclusions

This section begins with conclusions, discussions, and recommendations of survey data and syllabi data used for this study. The conclusions, discussions, and recommendations are then organized based by research questions for this study. The research questions are:

1. What is the supported cognitive level of teaching practice of the Agriculture Faculty at BAU based on RevBT (Anderson et al., 2001),
2. Does the supported cognitive level of teaching practice at BAU vary based on academic discipline, professional rank, or gender of the faculty members of the Faculty of Agriculture,
3. What discourages or encourages Agriculture Faculty at BAU from using teaching practices that support higher order cognitive levels based on RevBT (Anderson et al., 2001), and
4. What are the recommendations of the Agricultural Faculty members at BAU to create higher-order teaching practices?

Conclusions

Second Stage of Transformative Learning Theory: Critical Assessment and Examination of Assumptions

Critical Assessment of the Situation

At this stage of transformative learning theory, the learner critically assesses and reviews the existing knowledge, thoughts, and surroundings to understand their flaws and thereby more open to accept the new knowledge and develop assumptions (Mezirow, 2000). Findings support that the faculty members of BAU, mainly choose the teaching practices connected to remembering, understanding, and creating levels slightly more often than analyzing level of RevBT. However, faculty members should use all levels of RevBT for their classroom teaching. Remembering and understanding levels are categorized as lower order of RevBT. However, creating level is categorized as higher-level of RevBT. Thus, it can be concluded that faculty members mainly choose teaching practices, which connected to the lower levels of RevBT.

Moreover, data obtained by analyzing the CLOs of the course syllabi supported that action verbs associated with the understanding level were used with higher frequency than other levels of RevBT. Understanding level is connected to the lower levels of RevBT. However, like teaching practices, CLOs of the course syllabi should be connected to all levels of RevBT to assure the intended higher order teaching practices for the faculty members. Thus, from the findings of this study it can be concluded that action verbs of the CLOs of the course syllabi were connected to the lower levels of RevBT. Moreover, during critically examine the situation, faculty members have identified many factors, which discourage and encourage them to use higher order teaching practices in classes.

Discouraging Factors. Limitations that faculty members shared related to higher order teaching methods were lack of students' attention towards classroom teaching, lack of training facilities for the faculty members, inadequate classroom facilities, and rigid curriculum and assessment methods of BAU. Faculty members felt that most of the students only consult the reading materials to get the minimum pass marks in the exams and prepared themselves for job exams. Faculty members also stated that they have lack of training on higher order teaching practices. Moreover, faculty members stated that the classrooms of BAU are very noisy and hot. Faculty members said that they do not have any air conditioning system in classrooms. Thus, they have to use noisy celling fans for cool down the room temperature during hot and sunny summer. Therefore, noises from fans interfere to the hearing of students during lecturing as there is no sound systems installed in classrooms. Moreover, the sounds and honks from the vehicles from the adjacent roads of classrooms also create discomfort during lecturing. Faculty members also said that there are lack of furniture, advanced lab equipment, and internet facilities in classrooms. Faculty members also mentioned that there are too many students in classes to use higher-order teaching practices. Furthermore, faculty members stated that BAU has very rigid curriculum and syllabi for classroom teaching and assessment methods, which restrict them to use higher order teaching practices in classrooms.

Encouraging Factors. Faculty members mentioned multiple encouraging factors using higher order teaching practices in classrooms. Faculty members stated that higher order teaching practices improve the creativity and critical thinking abilities of students. Faculty members also assumed that higher order teaching practices improve problem solving skills, leadership skills, and analyzing level of students. Faculty members stated that higher order teaching practices increase teaching efficiency and create more dynamism in teaching. Moreover, faculty members stated that higher order teaching practices improve classroom environment. It saves the lecture time and maintain semester schedule. Finally, faculty members stated that higher order teaching practices help to create quality students and advance the overall education system. After critically assess the situation of the Agriculture Faculty at BAU, faculty members identified individual and contextual factors, which discourage and encourage them to use higher order teaching practices in class. Moreover, survey participants also make assumptions how the students' behavior, BAU tradition and policies, classroom environment, and teaching resources affect the higher order classroom teaching environment.

Examination of Assumption

For this study it was assume that the teaching practices significantly varied based on academic disciplines, professional ranks, and gender of the faculty members. Results from the Kruskal-Wallis Test and Mann Whitney U test showed that teaching practices related to higher level of RevBT significantly varied based on academic disciplines and gender of faculty members. Results from the Kruskal-Wallis Test showed that only the teaching practices related to the evaluating level of RevBT were significantly differently used in the different academic disciplines. Evaluating level of RevBT is considered as higher level of RevBT. Moreover, Mann-Whitney U test suggested that social science significantly uses lower number of teaching practices associated with evaluating level of RevBT than biological science and engineering science. However, the mean rank value of evaluating level of RevBT for engineering science is higher than the other two academic disciplines. Moreover, data obtained from Mann Whitney U test also showed that male faculty members were significantly more likely to use teaching practices related to analyzing level of RevBT than female faculty members. Analyzing level of RevBT is also considered as higher level of RevBT. Findings also suggested that faculty members from biological science significantly used less teaching methods from analyzing level than other levels of RevBT. Moreover, faculty members from social science disciplines significantly less used teaching practices from applying, evaluating, and creating levels of RevBT. Analyzing, evaluating, and creating level of RevBT are considered as higher level of RevBT. Therefore, it can be concluded that faculty members mainly support lower order teaching environment for the students. Critical teaching assessment also reveals that the higher educational teaching quality of the Agriculture Faculty at BAU needs improvement.

Third Stage of Transformative Learning Theory: Exploring Options and Plans

After critically examine the situation, the learners look for plans and options to strengthen the new knowledge that is the third stage of transformative learning theory. At this phase, learners go through extensive learning process to develop their knowledge and perspectives to the new knowledge (Mezirow, 2000). In this study, the survey respondents were asked to suggest plans to create higher order teaching practices through open-ended responses. Subsequently, faculty members proposed various options and plans to improve the teaching environment at the agriculture faculty at BAU. Faculty members recommended many strategies to create higher order teaching practices, including more group-based assignments, presentations, hands-on practical assignments, and field trips as class work. Moreover, survey respondents also suggested to organize different training program on higher order teaching practices for the faculty members. Faculty members also suggested to update the curriculum and learning assessment and examination system of BAU. Survey respondents also recommended to update the job examination system. Survey respondents recommended to consult with national job authority to include more questions from agricultural subjects for job recruitment examination. Moreover, faculty members recommended to reduce the number of students per class.

Astin's I-E-O Model: Environment

This study was directly linked to the environment factor of the Astin's I-E-O model for education. The environment factor consists of the experiences, which students gather during their college time (Astin, 1993). These experiences mainly include learning opportunities for the students, academic advising, instructional quality, quality of curriculum, faculty-student interaction, student-student interaction, and extra-curricular activities. Based on the findings of this study it can be concluded that the teaching practices and action verbs of the CLOs of the course learning outcomes are mainly connected to the lower levels of RevBT. Moreover, the responses from open ended questions also identified that faculty members identified many limitations including faculty characteristics, classroom environment, teaching resources, and BAU traditions. Faculty members claimed that they have lack of training on higher order teaching practices. Faculty members also have lack of incentives and freedom to use higher order teaching practices in classrooms. The classroom environment was not favorable to use higher order teaching practices in classrooms as mentioned by the faculty members. Faculty members mentioned that the classrooms of the

Agriculture Faculty at BAU are not well furnished. Faculty members also claimed that the rigid curriculum for classroom teaching and evaluation system of BAU also restricts them to use higher order teaching practices in classrooms. Faculty members also suggested many plans to improve the college environment that will lead to better students' outputs. Faculty members mainly pointed to improve faculty characteristics, BAU traditions, and classroom environment. They recommended to arrange advanced training for the faculty members on higher order teaching practices. Faculty should also change their mindset to create more higher order teaching in classes by adopting Bloom's Taxonomy in classroom education. Faculty members also suggested to change the BAU tradition in order to improve the college environment, which include updating course curricula, changing current assessment methods, introducing students' counselling system, reducing number of students per classes, rescheduling the lecture duration, and providing available teaching resources.

Astin's I-E-O Model: Inputs and Outcomes

This study was mainly founded on the environment factor of the Astin's I-E-O model. However, faculty members identified many points, which are connected to the input and outcomes factors of the Astin's I-E-O model. Inputs denote students' demographics, family background, and previous experience and outcomes cover students' knowledge, beliefs, attitudes, learning retention, behavior, and values, which exist in students after graduating from the college (Astin, 1993).

Inputs. Faculty members claimed that students are more interested in job preparation and they have lack of motivation in classroom studies and self-study. Faculty members claimed that students' previous mindset is responsible for such incidents. Their families and social context demand jobs after the graduation of students. Thus, they are more interested in job preparation, which impact the classroom environment. Moreover, the current job examination system also created pressure on the students. Thus, students have to prepare themselves for the jobs. Therefore, they can get a desirable job after their graduation. Faculty members also recommended to reduce the overall political pressure in order to create a better society for the students. This may change the students' mindsets before entering to the college to be more involved in classroom education instead of involving in political activities during college duration.

Outcomes. Faculty members also claimed that higher order teaching also improves certain students' characteristics, which improve outcomes of the Astin's I-E-O model. Higher order teaching improves creativity, critical thinking abilities, and leadership skills to the students. Thus, during leaving the university, students gain better generic skills to solve real-world problems. Moreover, higher-order teaching creates more congenial atmosphere in classrooms and assure effective teaching and learning and helps to produce quality graduates as identified by the faculty members.

Discussions

Of the six cognitive levels of RevBT, faculty members slightly more frequently used teaching practices from the lower level, including remembering and understanding level of RevBT for the classroom teaching at BAU. However, faculty members often use all levels of RevBT for their classroom instruction. Six specific teaching practices were selected from each level of RevBT. Faculty members also often use 32 teaching practices out of 36 teaching practices from all levels of RevBT. From the lower level of RevBT, teaching practices related to manipulating the rules and principles of applying level used seldom for classroom instruction. Moreover, from the higher level of RevBT, teaching practices that let students compare, contrast, and examine rules and principles at analyzing level also used seldom by the faculty members for classroom teaching.

Wang and Farmer (2008) found that Chinese instructors used lower order teaching practices for their students, which related to remembering, understanding, and applying. In this study, it was found that faculty members mainly select teaching practices from remembering, understanding, and creating level of RevBT for classroom instruction at the Agriculture Faculty of BAU. Wang and Farmer (2008) assumed that Chinese teachers believed in teachers' centered education system, which leads them to teach Bloom's lower order thinking skills. As a faculty member of BAU, it was also observed that faculty members of BAU also mainly follow one-way lecturing method for classroom teaching, which is founded on teachers' centered pedagogy. However, for this study, the teacher's perspective of the pedagogical selection was not considered. Thus, it could not be concluded that teacher-centered pedagogical approach was the key factor to select lower order teaching practices. Students require cognitive skills from all levels of RevBT for comprehensive development of their critical thinking abilities. The cognitive levels of RevBT are organized hierarchy fashioned based on complexity of knowledge. This means, students need to gain the knowledge from all levels of RevBT to produce effective learning. Therefore, each level of RevBT is equally important to grow creativity and critical thinking abilities of the students.

Moreover, higher percentages of action verbs of CLOs of the courses are associated with the lower order of RevBT than higher level of RevBT. Findings of analyzing the CLOs were also consistent with the findings of Bumpus et al. (2020) and Ahmed (2014). Bumpus et al. (2020) found that 88.26% of action verbs of the course objectives of different schools of USA were categorized under lower levels of RevBT. Moreover, Ahmed (2014) analyzed the action verbs of CLOs of an engineering degree program in Dubai and found that 81% of the action verbs are categorized under lower level of RevBT. The similar data trend for the courses was also observed of all academic disciplines and academic levels. It was found that in all academic years, higher percentages of action verbs of CLOs of the course syllabi were also associated with the lower order of RevBT.

Both biological sciences and engineering sciences significantly more used teaching practices related to the evaluating level of RevBT than social sciences. This likely happens because of the nature of courses offered by biological science and engineering science. These disciplines offer more mathematically based subjects and courses having more analytical contents. Thus, faculty members from biological science and engineering science disciplines choose significantly more teaching practices that provides more opportunities to the students improving evaluative skills than social science.

None of the cognitive levels of RevBT are significantly varied based on professional ranks of the faculty members. The nature of courses and recommended classroom-teaching practices are very forthright and similar at the Agriculture Faculty at BAU. Faculty members from all professional ranks followed one-way lecturing as a classroom teaching method. Moreover, faculty members from all professional ranks primarily selected the lower order teaching practices for their classroom teaching. Thus, selection of teaching practices was not varied across different professional ranks of the faculty members. Therefore, no variations were found between the teaching practices and professional ranks of the faculty members.

Findings also showed that male faculty members significantly more used teaching practices from the analyzing level than female faculty members. Table 4.5 showed that most female survey respondents for this study were lecturers or assistant professors. Moreover, as an existing faculty member of the Agriculture Faculty of BAU, the researcher observed that lecturers and assistant professors mainly assigned to the lower academic years. Therefore, it was assumed that female survey respondents were also assigned to lower academic years for classroom instruction. Thus, their teaching practices may less correspond with analyzing level of RevBT.

Before introducing the open-ended questions to identify the factors, which discourage and encourage the faculty members to use higher order teaching practices in classroom, a checklist was presented in the questionnaire on the recommended higher order teaching practices in classrooms. The checklist showed a list of recommended higher order teaching practices. This checklist helped the survey respondents to recall the higher order teacher practices. The survey respondents mainly blamed multiple students' characteristics, which restricted them to use higher order teaching practices. As Bangladesh is one of the most heavily populated countries, every year it produces huge number of graduates. However, the number of jobs is not adequate for the graduates. Agricultural graduates mainly choose two types of cadre services after completion of their undergraduate degree. First, the agricultural graduates can choose agricultural cadre service that is relevant with their subject area. Secondly, agricultural graduates may also choose general cadre service that includes administration, police, railway, postal service etc. Surprisingly, there are huge discriminations between agricultural cadre service and general cadre service in Bangladesh in terms of power dynamics, facilities, and social dignity. Faculty members assumed that students prepare themselves from the beginning of their under-graduate life for the general cadre jobs.

Moreover, the job examination system of Bangladesh is quite different. There are three phases for job examination, including preliminary exam, written exam, and oral examination, respectively. The preliminary exam is based on multiple choice questions from Bengali and English literature, basic mathematics, general science, and general knowledge. These subject areas are not addressed in agricultural science programs. Moreover, in written exams, open-ended questions were asked from the similar subjects. In addition, the examinees who wish to be recruited in agricultural cadre service must take exams related to agricultural science. Thus, the students need extra time to prepare themselves for these subjects. In the open-ended questions faculty suggested that students are not interested in higher order learning because they are preparing themselves for the job exam with emphasis on the general cadre service rather than the agricultural cadre. This phenomenon is unique to Bangladesh. Moreover, faculty members also stated that students are habituated with the traditional teaching- learning and closed book exam system. Therefore, faculty members stated that students felt less interest in higher order teaching approaches.

Rahman et al. (2019) also stated that Bangladesh has limited number of trained faculty members on higher order teaching practices. Faculty members also stated that they need more practice to use higher order teaching practices in classes. Moreover, a few faculty members responded that senior faculty members are not interested in using higher order teaching practices at BAU. Some faculty members are also busy with political and extra activities associated with university service instead of classroom teaching. Moreover, faculty members at BAU were not ready to adopt higher order teaching practices in classrooms. Thus, they were not able to engage students for group activities, brainstorming, critical thinking, and problem-based assignments in classrooms. Faculty members also stated that they need more budget and incentives to use higher order teaching practices in classes. Federal Ministry for Economic Cooperation and Development (2018), Wang (2007), and Wang & Farmer (2008) also reported that higher education related to agriculture in developing countries unable to foster group work, independent learning, critical thinking, and problem-solving abilities of students.

Moreover, lack of appropriate classroom environment and advanced lab facilities faculty members unable to use higher order teaching practices in classroom. Classroom area of BAU is small with large number of students, situated at the noisy places, and lack of sound systems and internet facilities in classrooms were also included as classroom related problems by the survey respondents. Maguire and Atchoarena (2003), Roberts (2016), Johanson and Shafiq (2010) found that higher education related to agriculture of the developing countries lack of field laboratories and advanced laboratory equipment.

Moreover, faculty members also stated that the lecture sessions are too short to practice higher order teaching practices. Faculty members also identified that they have lack of modern teaching aids and advanced reading materials to use higher order teaching practices in classes. Survey respondents also stated that BAU has very rigid curriculum for classroom teaching.

Faculty members mentioned that higher order teaching practices are very crucial for students to improve their critical thinking abilities, problem-solving skills, working in group skills, creativity, research opportunity, and confidence levels. Faculty members also mentioned that higher order teaching practices reduce pressure and help students for better job preparation. Wang and Farmer (2008) also stated that higher order teaching practices improve students' critical thinking abilities and problem-solving skills. Students may also satisfy with their exam results. Higher order teaching practices also help students to apply their knowledge in different contexts and connect the theoretical knowledge in practical field. Preus (2012) and Hattie and Donoghue (2016) also found that higher order teaching practices should create resonance the metacognitive skills of the learners and motivate them to acquire and consolidate deep learning. As well as higher order teaching helps the learners to transfer their knowledge in different contexts (Hattie & Donoghue, 2016).

Faculty members stated that higher order teaching practices help to create quality graduates for the global market, improves overall educational quality, alleviate university ranking, and promotes national growth. Johanson and Shafiq (2010) and Salmi (2009) stated that polytechnics, technical, and community colleges are essential for rapid knowledge and skill generation in both developed and developing countries. Altbach and Salmi (2011) also suggested that tertiary education fosters the globally competent, skilled, productive, and flexible graduate labor force in developing countries.

Moreover, quality agricultural education helps to assure food security by increasing agricultural production and reduce overall poverty (Atchoarena & Sedel, 2003). Atchoarena and Sedel (2003) also stated that educational level of the household heads in the developing countries also improves agricultural production. Moreover, Johanson and Shafiq (2010) found that access to higher education had a strong and positive correlation with real per-capita income over time in most of the developing countries. Maguire and Atchoarena (2003) suggested that “higher education related to agriculture may contribute to rural development by professional and technical education, policy advice on education for rural development, support to primary, secondary, vocational, and adult education for the rural space, and arranging the lifelong education for rural space” (p. 324). Thus, higher education related to agriculture is an essential paradigm of education that deals with improving the agricultural knowledge and skills of an individual (Maguire & Atchoarena, 2003).

Faculty members identified many fruitful and easily executable recommendations to create higher order teaching practices at classrooms. Of the recommendations, faculty members mainly focused on faculty characteristics and traditions of BAU. Faculty members felt that they could revise their teaching practices and policies in order to create higher order teaching practices. Survey respondents also stated that they need more training ion higher order teaching practices.

Faculty members said that the university should revise its existing curricula, syllabi, and assessment system. Survey respondents also indicated that they should include more higher-order teaching practices, including group-based-assignment, presentation, reflective reading assignment, live demonstration, and field trips in their classes. These assignments should carry the marks for the final exams. BAU is currently following the summative evaluation system. Kuri (2019) found that out of 100 marks for an examination at BAU, 10 marks reserve for class attendance, 20 marks reserve for class test, and 70 marks reserve for closed-book final exam system. Thus, students only rely previous year questions, handouts, and class notes. It was also observed that students rarely visited the library and participated in group studies to prepare their notes. Thus, there is a limited opportunity of the faculty members to include different assignments in daily classroom instructions. Therefore, students were unable to practice higher order learning skills in classes. Moreover, there is not teachers' evaluation system at BAU. The survey respondents urged to initiate faculty self-assessment and student-led assessment for the teaching.

The survey respondents also stated that BAU has a huge class size. They stated that the average class size for the theory and practical classes were 80 students and 40 students, respectively. Moreover, they also are not satisfied with current lecture duration. Presently, lecture duration for theory and practical classes were 55 minutes and 115 minutes, respectively. Thus, faculty members do not have adequate class time to use higher-order teaching practices for their classroom instruction. Therefore, faculty members recommended to increase the lecture duration proportionately. Moreover, faculty members have to cover the huge course content in short semester duration. Thus, they cannot get the feedback from the students. All these factors restrict to create higher order teaching practices in classrooms.

Recommendations

Recommendations for Practitioners

The practitioners may select more teaching practices from the higher order of RevBT and practice more frequently instead of often. The BAU authority, including departmental heads, dean, and Vice-chancellor may request the faculty members to choose more teaching practices from the higher order of RevBT for classroom teaching and assessing the learning outcomes. Moreover, the faculty members may return to their course syllabi and formulate the CLOs, which relate to the higher levels of RevBT.

Through this study, it was found that faculty members from biological science and social science significantly used less teaching methods from higher level of RevBT. Thus, faculty members from biological science and social science may use more teaching practices from higher level of RevBT. Moreover, the university may organize training for the faculty members of biological science and social science to create teaching practices from higher order of RevBT as many faculty members said that they have lack of training on higher order teaching practices.

Moreover, findings also show that female faculty members significantly less used teaching practices related to the analyzing level of RevBT. Thus, in future studies, researchers may explore the reasons behind this factor through exploratory study and class observation. The female faculty members should use more teaching practices, which support analyzing skills of the students. Moreover, the departmental heads, dean, director of the Institutional Quality Assurance Cell of BAU may offer training to the female faculty members on higher order teaching practices, especially for the analyzing level.

Moreover, the university authority should organize training programs for the faculty members on higher order teaching practices as many survey respondents stated that they have lack of training on higher order teaching practices at BAU. Faculty members should practice more higher order teaching practices in classroom and university authority should provide all necessary logistics to the faculty members to implement higher order teaching practices in classrooms and hold the motivation of the faculty members. Faculty members assumed that the current job recruitment system needs to be updated. Therefore, the BAU administration may discuss with the Bangladesh Public Service Commission and share a common vision in job recruitment for the BAU graduates. This process will also help to disorient the dilemma of the employers and the faculty members about the expected graduate skills and requirement of the job markets. Thus, faculty members can select appropriate teaching practices, which help to introduce desired employability skills to the students. Moreover, the higher administrative authority of BAU should take prompt action to revise the current course curriculum and evaluation system of BAU. The authority should also reduce the number of students in both theory and practical classes to assure better classroom management for the faculty members. The appropriate authority (e.g., IQAC at BAU) should also initiate self-evaluation for the current faculty members to have accountability in the present teaching process as it is recommended by faculty members.

Recommendations for Future Studies

In this study, the level of teaching practices for each individual academic year was not examined. Thus, in future studies, the researchers may see the differences of the teaching practices of each academic year based on RevBT. Moreover, in future studies, the researchers may assess the quality of students' responses for the questions of different levels of RevBT. This will help the researchers to understand how the students perform to respond to the questions from different levels of RevBT. In future, researchers may also explore the teacher's perspective of the pedagogical selection as this study did not consider this paradigm. In future studies, the researchers may also explore the students' perspectives on classroom teaching practices to cross-validated the findings of this study. Because all the findings of this study were developed from the self-reported data of the faculty members. Moreover, in future studies, the researchers may examine how the teaching perspectives i.e., student-centered pedagogy and teacher-centered pedagogy leads to select the teaching practices from different levels of RevBT. Class observation and monitoring should be conducted along with the qualitative study in future to understand how faculty members choose innovative teaching methods for their classes to encourage higher order thinking skills for students. In this study, the cognitive level of learning was only considered to collect, analyze, and report the data. Thus, in the future studies, the researchers may explore how the teaching process at BAU relate to the different subcategories of knowledge. In future studies, the researchers may explore how the teaching practices from different levels of RevBT mixed up together to provide classroom instruction for appropriate learning.

For this study, only three demographic variables were selected of the faculty members. These variables included academic discipline, professional rank, and gender of the faculty members. Thus, in future studies researchers may select other demographical variables, including age education, place of education, training, teaching experience, etc. to explore the differences with teaching practices. Moreover, from the discussion, it can be recommended that the female faculty members may use more teaching practices from the analyzing level of RevBT for their classroom teaching. However, in future studies, researchers may also investigate why the female faculty members are assigned to take the classes from lower academic years.

The responses of the open-ended questions were not elaborative. Most of the responses were provided as bullet list. Thus, detailed answers on these problems were not found. Therefore, in future studies, researchers may use qualitative data collection methods, including in-depth personal interview and focus group discussions to explore the statements of the survey respondents.

Concluding Remarks

From the above discussion, it is clearly evident that both teaching methods and CLOs of the courses of the Agriculture faculty at BAU were related the lower order of RevBT. Moreover, faculty members from biological science and engineering used more teaching practices from evaluating level of RevBT than social science disciplines. Male faculty members also used more teaching practices related to analyzing level than female faculty members. Faculty members identified that they have lack of training, standard teaching resources to use higher order teaching practices. Moreover, they also said that students of the

Agriculture Faculty at BAU more interested in job preparation than classroom education. However, faculty members also felt that higher order teaching practices can improves the creativity and critical thinking abilities for students and brings dynamisms in teaching. Faculty members also recommended that BAU should revise its curriculum, syllabi, and assessment strategies to create higher order teaching practices in classrooms. They also believed that teachers should take the lead to revise their pedagogical approaches and change their mindset to create higher order teaching practices in classrooms. Therefore, based on the previous discussions, the following recommendations were suggested to improve the higher order teaching practices at the Agriculture Faculty of BAU:

1. Faculty members should select and use teaching practices from the higher level of RevBT, including analyzing, evaluating, and creating level of RevBT more frequently.
2. Faculty members should select and use more action verbs from the higher level of RevBT, including analyzing, evaluating, and creating level of RevBT to design the course learning outcomes.
3. More training needed for the female faculty members of BAU on analyzing level of RevBT.
4. Faculty members should also include different group-based assignments, brain storming sessions, and independent projects in their pedagogical approaches.
5. The university should revise their existing curricula and assessment techniques and give more freedom to the faculty members to choose their teaching and assessment methods.
6. The university should also organize routinely refreshers training programs for the faculty members on higher order teaching practices.

7. Faculty members assumed that the current job recruitment system needs to be updated. Therefore, the BAU administration may discuss with the Bangladesh Public Service Commission and share a common vision in job recruitment for the BAU graduates. This process will also help to disorient the dilemma of the employers and the faculty members about the expected graduate skills and requirement of the job markets. Thus, faculty members can select appropriate teaching practices, which help to introduce desired employability skills to the students.

The purpose of this study was to understand the teaching practices of the Agriculture Faculty at BAU. This study is at the intersection of the stage 2 and stage 3 of transformative learning theory and the environment factor of Astin's I-E-O model. In this study, the teaching practices and course curriculum of the Agriculture Faculty at BAU was critically assessed. Faculty members suggested recommendations to create higher order teaching practices in classroom. Practitioners can use the findings of this study to revise their choice of teaching practice to support environment that helps to develop critical thinking in students. The Institutional Quality Assurance Cell (IQAC), BAU, and the Agriculture Faculty at BAU may use the findings to ensure a learning environment that facilitates quality teaching for the students. Thus, in the long run, the graduates will be able to gain better job placement and be better equipped to solve the emerging national and global problems in the field of agricultural science.

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Appendix A: Query Email to Validate the Sampling Frame

Subject: Request to validate the sampling frame of your department
Respected Dr. /Mr./Mrs.,
I am Subrato Kumar Kuri, PhD candidate in Agricultural, Leadership, and Community Education at Virginia Tech and on study leave as an Assistant Professor, Bangladesh Agricultural University. I am currently collecting data to understand the teaching practices of the Agriculture Faculty at BAU. For my dissertation project, I have selected Bangladesh Agricultural University as my study location. I am contacting you because your department is offering course(s) to the Agriculture faculty of BAU. For, conducting the study, I have selected you and your departmental colleagues as the potential participants of my study. Thus, I have generated a Microsoft Excel sheet (attached below) from your website, which shows the name, professional rank, gender, service status, and email address of your departmental colleagues.
May I request you to review the attached document and make the required revisions as necessary? I want to make sure all faculty in your department are included and listed appropriately by faculty rank and status as well as that I have the correct contact information for them. Please review and return the document within next five business day.
Should you have questions about the study, please contact us using the information listed below.
Thank you!
Sincerely,

Subrato Kumar Kuri, Student Researcher, subrato@vt.edu
Dissertation Advisor:
Dr. Karen A. Vines, Chairman, Dissertation Committee, kvines@vt.edu

Appendix B: Recruitment Email for the Census Survey

Subject: Request to participate the census to understand the teaching process of the Agriculture faculty at BAU

Respected Dr./Mr./Mrs.,

I am Subrato Kumar Kuri, PhD candidate in Agricultural, Leadership, and Community Education at Virginia Tech. I am currently on study leave as an Assistant Professor from Bangladesh Agricultural University. I am currently collecting data to understand the teaching practices of the Agriculture Faculty at BAU as part of my dissertation project. I would appreciate your participation in this survey to help fulfill my research objectives. The survey will take approximately 10 minutes to complete. You may withdraw yourself from the study at any time. You may use any computer device (i.e., Windows or Mac) or mobile devices (e.g., both android and i-OS) to participate in the survey.

Findings from this study will be used in future publications and presentations. All findings of the study will be presented in a summary format that does not reveal your identity. Attached to this email is a copy of a consent document, which provides more information about this study. Your participation is voluntary and does not affect your current or future involvement with Virginia Tech.

Should you have questions about this study, please contact me or my advisor using the information listed below.

Thank you!

Sincerely,

Subrato Kumar Kuri, PhD Student Researcher, subrato@vt.edu

Dissertation Advisor:

Dr. Karen A. Vines, Chairman, Dissertation Committee, kvines@vt.edu

Appendix C: Informed Consent letter for the Census-Survey

VIRGINIA POLYTECHNIC INSTITUTE AND STATE UNIVERSITY

Title of Project: Exploring Teaching Practices of the Agricultural Education at Bangladesh Agricultural University (BAU)

Investigators: Dr. Karen A. Vines and Subrato K. Kuri

I. Purpose of this Research/Project

To achieve the goal of the proposed study, the overarching research question is "What is the level of teaching at the Agriculture Faculty of BAU and how do the teaching practices compatible with different cognitive levels of RevBT (Anderson et al., 2001)?" The underlying research questions for this study are as follows:

1. What is the supported cognitive level of teaching practice of the Agriculture Faculty at BAU based on revised Bloom's Taxonomy (Anderson et al., 2001)?
2. Does the supported cognitive level of teaching practice vary based on academic discipline, professional rank, or gender of the faculty members?
3. What discourages or encourages Agriculture Faculty at BAU from using teaching practices that support higher order cognitive levels based on revised Bloom's Taxonomy (Anderson et al., 2001)?
4. What are the recommendations of the Agricultural Faculty members at BAU to create higher order teaching practices?

II. Procedures

If you agree to participate, you will participate in an online survey. As a faculty member of BAU, your response is important and opportunity to participate is limited. Your name will not be recorded or attached to any use of the recording. The census-survey will last approximately 10 minutes.

III. Risks

There are no known risks associated with participation in the key informant interview.

IV. Benefits

No promise or guarantee of benefits has been made to encourage you to participate. However, you may have the satisfaction of knowing that you have contributed important information to a study to improve the BAU teaching and learning process. Participants may contact the researcher for a summary of the research results.

V. Extent of Anonymity and Confidentiality

The information concerning your participation in the study will be kept entirely confidential. At no time will the researchers release the data from the study in a way that identifies you as a part of this study to anyone other than individuals working on the project without your written consent. Your survey participation and responses will not affect your participation in any future Virginia Tech program.

Each survey response will be stored in Virginia Tech Qualtrics^{XM}. The Qualtrics sheet will be exported to Microsoft Excel sheet, which will be kept on a password-protected computer. Only the researchers will have access to the files. The Microsoft Excel sheet will be erased at the conclusion of this research project.

It is possible that the Virginia Tech Institutional Review Board (IRB) may view this study's collected data for auditing purposes. The IRB is responsible for the oversight of the protection of human subjects involved in research.

VI. Compensation

Participants who complete the survey will have the opportunity to participate in a drawing. Twenty respondents will randomly selected to receive a $5 souvenir as a token of our appreciation for their participation in this project.

VII. Freedom to Withdraw
Participation in this study is entirely voluntary. Refusal to participate will involve no penalty or loss of benefits. Similarly, you may withdraw from this study at any time without penalty or loss of benefits.

VIII. Subject's Responsibilities
I voluntarily agree to participate in this study. I have the following responsibilities:

- Participate in a 16 minute online survey, and
- Ask questions of the researcher about the study at any time.

IX. Subject's Permission
If questions arise about research subjects' rights or any concerns about the conduct of this study, please contact The Virginia Tech Institutional Review Board, irb@vt.edu or 540-231-3732.
If the questions relate to content and findings of this particular study, please contact one of the project investigators:

- Subrato Kumar Kuri, Student Researcher, subrato@vt.edu
- Dr. Karen Vines, kvines@vt.edu

Consent will be given at the onset of the survey.

Appendix D: Invitation Email for the Census Survey

Subject: Request to participate the census to understand the teaching process of the Agriculture faculty at BAU
Respected Dr./Mr./Mrs.,
I am Subrato Kumar Kuri, PhD candidate in Agricultural, Leadership, and Community Education at Virginia Tech. I am currently on study leave as an Assistant Professor from Bangladesh Agricultural University. I am currently collecting data to understand the teaching practices of the Agriculture Faculty at BAU as part of my dissertation project. I would appreciate your participation in this survey to help fulfill my research objectives. The survey will take approximately 10 minutes to complete. You may withdraw from the study at any time. To participate in the survey, use the following QualtricsXM link. You may use any computer device (i.e., Windows or Mac) or mobile devices (e.g., both android and i-OS) to participate in the survey. The deadline to respond to the survey is July 31, 2020.
Follow this link to the Survey:
Take the Survey
Or copy and paste the URL below into your internet browser:
https://virginiatech.qualtrics.com/jfe/form/SV_74jK1Lp8URWyv6l?Q_DL=WsNEPkXqH83F8hu_74jK1Lp8URWyv6l_MLRP_8jqBUVC2DddOeKV&Q_CHL=email
Findings from this study will be used in future publications and presentations. All findings of the study will be presented in a summary format that does not reveal your identity. Attached to this email is a copy of a consent document, which provides more information about this study. Your participation is voluntary and does not affect your current or future involvement with Virginia Tech.
Thank you!

Sincerely,

Subrato Kumar Kuri, PhD Student Researcher, subrato@vt.edu

Dissertation Advisor:
Dr. Karen A. Vines, Chairman, Dissertation Committee, kvines@vt.edu

Appendix E: Survey Tool

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

Title of Project: Exploring Teaching Practices of the Agricultural Education at Bangladesh Agricultural University (BAU)
Investigators: Dr. Karen A. Vines and Subrato K. Kuri

I. Purpose of this Research/Project

To achieve the goal of the proposed study, the overarching research question is "What is the level of teaching at the Agriculture Faculty of BAU and how do the teaching practices compatible with different cognitive levels of RevBT (Anderson et al., 2001)?" The underlying research questions for this study are as follows:

1. What is the supported cognitive level of teaching practice of the Agriculture Faculty at BAU based on revised Bloom's Taxonomy (Anderson et al., 2001)?
2. Does the supported cognitive level of teaching practice vary based on academic discipline, professional rank, or gender of the faculty members?
3. What discourages or encourages Agriculture Faculty at BAU from using teaching practices that support higher order cognitive levels based on revised Bloom's Taxonomy (Anderson et al., 2001)?
4. What are the recommendations of the Agricultural Faculty members at BAU to create higher order teaching practices?

II. Procedures

If you agree to participate, you will participate in an online survey. As a faculty member of BAU, your response is important and opportunity to participate is limited. Your name will not be recorded or attached to any use of the recording. The census-survey will last approximately 10 minutes.

III. Risks

There are no known risks associated with participation in the key informant interview.

IV. Benefits

No promise or guarantee of benefits has been made to encourage you to participate. However, you may have the satisfaction of knowing that you have contributed important information to a study to improve the BAU teaching and learning process. Participants may contact the researcher for a summary of the research results. Moreover, you may be randomly selected as one of the 20 lucky winners, who may get a souvenir, which is equivalent to $5 cash prize.

V. Extent of Anonymity and Confidentiality

The information concerning your participation in the study will be kept entirely confidential by using your email address. No name identity will not be asked during the survey. At no time will the researchers release the data from the study in a way that identifies you as a part of this study to anyone other than individuals working on the project without your written consent. Your census-survey participation and responses will not affect your participation in any future Virginia Tech program.

Each census-survey response will be stored in Virginia Tech QualtricsXM. The Qualtrics sheet will be exported to Microsoft Excel sheet, which will be kept on a password-protected computer. Only the researchers will have access to the files. The Microsoft Excel sheet will be erased at the conclusion of this research project.

It is possible that the Virginia Tech Institutional Review Board (IRB) may view this study's collected data for auditing purposes. The IRB is responsible for the oversight of the protection of human subjects involved in the research.

VI. Compensation

None will be provided.

VII. Freedom to Withdraw

Participation in this study is entirely voluntary. Refusal to participate will involve no penalty or loss of benefits. Similarly, you may withdraw from this study at any time without penalty or loss of benefits.

VIII. Subject's Responsibilities

I voluntarily agree to participate in this study. I have the following responsibilities:

- Participate in a 10-minute online survey and
- Ask questions of the researcher about the study at any time.

IX. Subject's Permission

If the questions relate to content and findings of this particular study, please contact one of the project investigators:

- Subrato Kumar Kuri, Student Researcher, Agricultural, Leadership, and Community Education, Virginia Tech, subrato@vt.edu
- Dr. Karen Vines, Assistant Professor, Agricultural, Leadership, and Community Education, Virginia Tech, kvines@vt.edu

I have read the Consent Form and conditions of this project. I have had all my questions answered. I am not a minor and give my voluntary consent to participate in this study:

☐Yes ☐No

Start of Block: Default Question Block

Please add your email address below:

____

Please provide your professional affiliation:

☐Lecturer

☐Assistant Professor

☐Associate Professor

☐Professor

Please select your gender identity

☐Male

☐Female

☐Other Click or tap here to enter text.

Please select your academic department.
☐Agricultural Chemistry
☐Agricultural Economics
☐Agricultural Extension Education
☐Agricultural Statistics
☐Agroforestry
☐Agronomy
☐Animal science
☐Biochemistry & Molecular Biology
☐Biotechnology
☐Computer Science & Mathematics
☐Crop Botany
☐Entomology
☐Environmental science
☐Farm Power & Machinery
☐Genetics and Plant breeding
☐Horticulture
☐Languages
☐Plant Pathology
☐Rural Sociology
☐Soil Science

	Always	Almost Always	Often	Seldom	Almost Never	Never
1. I allow students to define concepts in my class	☐	☐	☐	☐	☐	☐
2. I encourage students to describe concrete concepts in my class	☐	☐	☐	☐	☐	☐
3. I help students apply rules and principles in my class	☐	☐	☐	☐	☐	☐
4. I let students distinguish rules and principles in my class	☐	☐	☐	☐	☐	☐
5. I plan activities that will encourage students to plan problem solving in my class	☐	☐	☐	☐	☐	☐
6. I create conditions within which students evaluate their cognitive strategy	☐	☐	☐	☐	☐	☐

	Always	Almost Always	Often	Seldom	Almost Never	Never
7. I allow students to memorize concepts in my class	☐	☐	☐	☐	☐	☐
8. I encourage students to discuss concrete concepts in my class	☐	☐	☐	☐	☐	☐
9. I help students demonstrate rules and principles in my class	☐	☐	☐	☐	☐	☐
10. I let students differentiate rules and principles in my class	☐	☐	☐	☐	☐	☐
11. I create conditions within which students rate their cognitive strategy	☐	☐	☐	☐	☐	☐
12. I plan activities that will encourage students to propose problem solving in my class	☐	☐	☐	☐	☐	☐

	Always	Almost Always	Often	Seldom	Almost Never	Never
13. I allow students to repeat concepts in my class	☐	☐	☐	☐	☐	☐
14. I encourage students to explain concrete concepts in my class	☐	☐	☐	☐	☐	☐
15. I help students translate rules and principles in my class	☐	☐	☐	☐	☐	☐
16. I let students compare rules and principles in my class	☐	☐	☐	☐	☐	☐
17. I create conditions within which students judge their cognitive strategy	☐	☐	☐	☐	☐	☐
18. I plan activities that will encourage students to design problem solving in my class	☐	☐	☐	☐	☐	☐

	Always	Almost Always	Often	Seldom	Almost Never	Never
19. I allow students to name concepts in my class	☐	☐	☐	☐	☐	☐
20. I encourage students to identify concrete concepts in my class	☐	☐	☐	☐	☐	☐
21. I help students manipulate rules and principles in my class	☐	☐	☐	☐	☐	☐
22. I let students contrast rules and principles in my class	☐	☐	☐	☐	☐	☐
23. I create conditions within which students justify their cognitive strategy	☐	☐	☐	☐	☐	☐
24. I plan activities that will encourage students to arrange problem solving in my class	☐	☐	☐	☐	☐	☐

	Always	Almost Always	Often	Seldom	Almost Never	Never
25. I allow students to recall concepts in my class	☐	☐	☐	☐	☐	☐
26. I encourage students to recognize concrete concepts in my class	☐	☐	☐	☐	☐	☐
27. I help students practice rules and principles in my class	☐	☐	☐	☐	☐	☐
28. I let students critique rules and principles in my class	☐	☐	☐	☐	☐	☐
29. I create conditions within which students summarize their cognitive strategy	☐	☐	☐	☐	☐	☐
30. I plan activities that will encourage students to organize problem solving in my class	☐	☐	☐	☐	☐	☐

	Always	Almost Always	Often	Seldom	Almost Never	Never
31. I let students critique rules and principles in my class	☐	☐	☐	☐	☐	☐
32. I encourage students to locate concrete concepts in my class	☐	☐	☐	☐	☐	☐
33. I help students illustrate rules and principles in my class	☐	☐	☐	☐	☐	☐
34. I let students examine rules and principles in my class	☐	☐	☐	☐	☐	☐
35. I create conditions within which students appraise their cognitive strategy	☐	☐	☐	☐	☐	☐
36. I plan activities that will encourage students to modify problem solving in my class	☐	☐	☐	☐	☐	☐

37. Please select the higher order teaching practices that you are using in your classes:
    ☐Follow students' centered pedagogy with complex goal and promote collaborative learning atmosphere in the classroom
    ☐Provide surprise reading materials and quiz tests for the students to recognize the level of engagement, preparation, and understanding of students about previous lessons
    ☐Encourage critical thinking of students to create solutions to complex issues integrating multiple viewpoints and sources of information
    ☐Conduct short-writing test periodically and provide appropriate feedback
    ☐Assign group-based case studies related to the real-life problems that require support from evidence-based scientific articles to solve the issue
    ☐Provide open-ended questions that involve critical brainstorming to assess the critical thinking abilities
    ☐Include recent scientific articles in compulsory reading materials
    ☐Conduct numerous exams throughout the semester (e.g., weekly reflection, chapter-end quiz test, mid-term papers, etc.) by formulating test questions based on higher-levels of Bloom's Taxonomy
    ☐Help students to learn 'how to think' not 'what to think'
    ☐Others (Please provide other higher order teaching strategies that you are using in your class): Click or tap here to enter text.

38. What challenges do you face to use more higher order teaching practices in your classes? (Please provide details answer)
Click or tap here to enter text.

39. What benefits do you see in using more higher order teaching practices in your teaching? (Please provide details answer)
Click or tap here to enter text.

40. What are the major recommendations that you provide to create higher order teaching practices in the Agriculture Faculty of BAU? (Please provide details answer)
Click or tap here to enter text.

Thank you so much for your kind responses!

Appendix F: Appreciation Email to Participate in the Census Survey

Subject: Appreciation letter to participate in the study

Respected Dr. /Mr./Mrs.,

Thank you so much for your kind participation in the study "Exploring Teaching Practices of the Agricultural Education at Bangladesh Agricultural University (BAU)."
I hope to share my research findings with you shortly!

Thank you!

Sincerely,

Subrato Kumar Kuri, PhD Candidate, subrato@vt.edu

Dissertation Advisor:
Dr. Karen A. Vines, Chairman, Dissertation Committee, kvines@vt.edu

Appendix G: Reminder Email to Participate in the Census Survey

Subject: Gentle Reminder: Survey on the teaching process of the Agriculture faculty at BAU

Respected Dr. /Mr./Mrs.,
I am Subrato Kumar Kuri, PhD candidate in Agricultural, Leadership, and Community Education at Virginia Tech and on study leave as an Assistant Professor, Bangladesh Agricultural University. I am currently collecting data to understand the teaching practices of the Agriculture Faculty at BAU. For my dissertation project, I have selected Bangladesh Agricultural University as my study location. May I request you to respond to the survey by July 31.
Follow this link to the Survey:
${l://SurveyLink?d=Take the Survey}
Or copy and paste the URL below into your internet browser:
${l://SurveyURL}
You can use any computer and mobile interface to respond the survey. Moreover, I have attached exact form of the on-line questionnaire for your kind consideration to respond. After finishing your responses on the attached Microsoft Word (.docx) file, please rename the file with your last name and date of return and e-mailed to subrato@vt.edu (The tool can be downloaded from here: Survey tool teaching practices@bau). Please disregard this email, if you already submitted your responses.
I hope to share my research findings with you shortly!
Thank you!
Sincerely,

Subrato Kumar Kuri, Student Researcher, subrato@vt.edu

Dissertation Advisor:
Dr. Karen A. Vines, Chairman, Dissertation Committee, kvines@vt.edu

Appendix H: List of CLOs of the Course Syllabi with Action Verb Lists

Courses	Course Learning Outcomes	Action Verb 1	Action Verb 2	Action Verb 3	Action Verb 4
AGRON 1101; Course Title: Fundamentals of Agronomy	Define Agronomy and explain its concept and principles	Remembering	Understanding		
	Justify crop suitability in relation to agro-climatic and geographical conditions	Evaluating			
	Classify crops and describe the cropping practices	Analyzing	Remembering		
	Explain the concept, functions, sources, and management of plant nutrients	Understanding			
	Describe the planting materials and cultural operations of field crops	Remembering			
	Identify different field crops, soil, manures and fertilizers, farm implements and meteorological instruments	Applying			
AGRON 1102; Course Title: Introductory Agronomic Practices	Demonstrate composting methods, crop production practices and different intercultural operations	Understanding			
	Compute the efficiencies of farm implements and requirements of fertilizer and manures	Analyzing			
	Evaluate the effects of different plant nutrients on crop growth and yield	Evaluating			
	Illustrate and interpret the weather data in relation to cropping season	Understanding	Understanding		
AGRON 1201; Course Title: Seed Science and Technology	Define seed and delineate seed quality	Remembering	Remembering		
	Describe the seed crop production techniques	Remembering			
	Explain the relation of seed physiology with its storage longevity and quality	Evaluating			
	Discuss seed certification and quality control systems	Understanding			
	Describe the techniques of seed treatments, priming and dormancy breaking	Remembering			
AGRON 1202; Course Title: Seed Science and	Identify seed and illustrate its structure	Applying	Understanding		
	Describe the procedure of seed sampling, treatment and grading	Remembering			
	Demonstrate seed moisture, purity, germination, viability and vigour tests	Understanding			

Courses	Course Learning Outcomes	Action Verb 1	Action Verb 2	Action Verb 3	Action Verb 4
Technology	Compute seed rate for crop production	Applying			
	Write a report on seed crop production and processing	Remembering			
AGRON 2101; Weed Science	Define and classify weeds and describe their biology and ecology	Remembering	Analyzing		
	Discuss dimensions of crop-weed competition, competitive ability of weeds and allelopathy	Understanding			
	Explain concept, principles and strategies of weed management	Understanding			
	Illustrate the mechanisms of herbicidal weed control	Understanding			
	Interpret the impact of herbicides on crop, weed and environment	Understanding			
AGRON 2102; Weed Science	Identify weed and weed seed	Applying			
	Describe the life cycle and morphology of major cropland weeds	Remembering			
	Calibrate a sprayer and calculate herbicide rates	Evaluating	Analyzing		
	Demonstrate hands-on practice of herbicide application in the field	Understanding			
	Perform a weed survey and write a report	Applying			
AGRON 3201; Crop Husbandry	Explain the role of different factors on growth, development, and yield of field crops	Understanding			
	Describe water use efficiency and water management aspects in crop production	Remembering			
	Justify the need of balanced fertilization and fertilizer recommendation in crop production	Evaluating			
	Describe the production technology of cereal, pulse, oil seed, fiber, sugar, beverage and narcotic crops	Remembering			
	Discuss the postharvest processing of cereal, pulse, oil seed, fiber, sugar, beverage, and narcotic crops	Understanding			
AGRON 3202; Crop Production Technology	Conduct an experiment on plant density	Applying			
	Prepare and manage an ideal nursery bed of rice and tobacco	Applying	Analyzing		
	Describe different sugarcane plantation methods and green manuring techniques	Remembering			
	Prepare irrigation schedule for field crops	Creating			
	Calculate cost of production and economics of major field crops	Analyzing			
AGRON 4201;	Illustrate the integrated crop management and its relation with crop yield and quality	Understanding			

Courses	Course Learning Outcomes	Action Verb 1	Action Verb 2	Action Verb 3	Action Verb 4
Cropping System and Farm Management	Describe the planning and management of agricultural farms	Remembering			
	Explain the agro-ecosystems and cropping systems of Bangladesh	Understanding			
	Discuss sustainable crop management systems and yield forecasting methods	Understanding			
	Describe precision agriculture and its relation with crop yield maximization	Remembering			
	Conduct a field experiment and prepare a project report	Applying	Creating		
AGRON 4202; Farms and Farming Practices	Develop a layout of an agricultural farm and maintain farm records	Creating	Analyzing		
	Illustrate the land use systems and crop statistics of Bangladesh	Understanding			
	Prepare crop rotation schedule, crop calendar and cropping scheme	Creating			
	Perform crop cutting experiment, agro-ecosystem analysis and prepare reports	Applying	Creating		
AGRON 3101; Conservation Agriculture and Organic	Explain the concept, components and significance of conservation agriculture (CA) and organic farming (OF)	Understanding			
	Describe the relationships of CA and OF with sustainable agriculture	Remembering			
	Explain the ways and means for soil, water, nutrient and weed management protocols in CA and OF	Evaluating			
	Describe the components of CA and OF	Remembering			
	Analyze the scope and challenges of CA and OF in Bangladesh	Analyzing			
AGRON 3203; Precision Agriculture and Crop Modeling	Described the concepts and scope of precision agriculture	Remembering			
	Explain the use of GIS and different remote sensing tools and models in precision agriculture	Evaluating			
	Relate the application of Variable Rate Technology (VRT) in precision agriculture	Understanding			
	Evaluate different crop yield forecasting models and their applications	Evaluating			
AGRON 4101; Crop Production under Vulnerable	Explain the crop production scenarios of vulnerable ecosystems	Understanding			
	Illustrate the vulnerable ecosystems of hill areas and suggest the agronomic measures for improving crop production in that areas	Understanding	Evaluating		

Courses	Course Learning Outcomes	Action Verb 1	Action Verb 2	Action Verb 3	Action Verb 4
	Elucidate the vulnerable ecosystems of haor areas and suggest the agronomic measures for improving crop production in that areas	Understanding	Evaluating		
	Demonstrate the vulnerable ecosystems of salinity affected coastal areas and suggest the agronomic measures for improving crop production in that areas	Understanding	Evaluating		
	Illustrate the vulnerable ecosystems of drought prone areas and suggest the agronomic measures for improving crop production in that areas	Understanding	Evaluating		
SS 1101; Soil Genesis and Soil Physics	Interpret soil and its components	Understanding			
	Describe rocks and minerals and their weathering processes, soil forming processes and factors	Remembering			
	Interpret soil physical properties & processes and their significance in crop production	Understanding			
	Illustrate water cycle and hydraulic properties of soils to prepare irrigation schedule	Understanding			
	Interpret thermal properties of soils and modify soil temperature	Understanding	Creating		
	Explain soil mechanical processes, particle size analysis and predict plough pan formation in soil	Understanding	Understanding		
SS 1102; Soil Genesis and Soil Physics	Discuss safety measures to conduct laboratory analysis	Understanding			
	Collect and process soil samples for quantifying soil density and porosity	Applying	Applying		
	Identify rocks and minerals	Applying			
	Estimate the moisture status of soil in different conditions	Evaluating			
	Predict nutrient flow in soil and estimate water and solute movement in soil	Understanding	Evaluating		
	Classify soil into different textural types	Analyzing			
SS 2101; Soil Survey and Soil Conservation	Perform soil survey and prepare soil survey map and report	Applying	Creating		
	Interpret general soil types and agro-ecology of Bangladesh	Understanding			
	Analyze the soil related crop production constraints in Bangladesh	Analyzing			

Courses	Course Learning Outcomes	Action Verb 1	Action Verb 2	Action Verb 3	Action Verb 4
SSS 2102; Soil Survey and Soil Conservation	Design land use for crops and cropping patterns and evaluate the soil-crop management strategies	Creating	Evaluating		
	Assess soil erodibility and apply methods for soil conservation	Evaluating	Applying		
	Conduct qualitative estimation of soil texture	Applying			
	Perform qualitative assessment of soil properties and reaction (pH)	Applying			
	Interpret the effects of alkalinity & salinity level on soils and plants processes	Understanding			
	Interpret soil genesis and horizon differentiation	Understanding			
	Compute aggregate size stability in soil	Applying			
	Explain the geomorphological processes related to soil erosion	Understanding			
SS 3101; Soil Chemistry	Diagnose the properties of soil colloids and silicate clays to plan effective management of soil silicates	Analyzing			
	Interpret the influence of ion exchange on plant nutrients dynamics	Understanding			
	Assess lime requirement and explain the mechanisms of nutrient uptake by plants	Evaluating	Understanding		
	Evaluate soil quality on the basis of soil organic matter content and plan for sustainable techniques of managing soil fertility	Evaluating	Creating		
SS 3102; Soil Chemistry	Interpret nutrient dynamics and gaseous fluxes in submerged soils	Understanding			
	Evaluate the fertility status of soil in-terms of soil organic carbon	Evaluating			
	Predict nutrient retention capacity of the soil	Understanding			
	Evaluate soil reaction to modify soil pH	Evaluating			
	Interpret the redox potential of wetland soil	Understanding			
	Identify the clay minerals to plan effective management of soil silicates	Applying			
	Perform the measurement of methane exchanges between soils and the atmosphere	Applying			
SS 4201; Soil	Illustrate soil microbial diversity and its role in soil fertility	Understanding			

Courses	Course Learning Outcomes	Action Verb 1	Action Verb 2	Action Verb 3	Action Verb 4
Microbiology and Soil Fertility	Explain biological nitrogen fixation systems and beneficial role of bio-fertilizers and mycorrhiza	Understanding			
	Identify the mechanisms and factors of nutrient availability in soils for crop uptake.	Applying			
	Assess soil fertility status and make fertilizer recommendations for crops & cropping patterns	Evaluating	Applying		
	Explain the functions of plant nutrients for sustainable crop production	Understanding			
	Identify causes of soil fertility depletion in Bangladesh and management options for sustainable soil fertility	Applying			
SS 4201; Soil Microbiology and Soil Fertility	Perform quick assessment of nutrients	Applying			
	Calculate the limiting nutrient elements (N, P, K, S) in soil for crop production	Analyzing			
	Demonstrate agents of sterilization	Understanding			
	Characterize and quantify bacterial population in soil and inoculants	Understanding	Evaluating		
	Design and plan bio-fertilizers production techniques	Creating	Creating		
SS 3101; Soil Pollution	Illustrate the impacts of soil pollution on food security and agricultural productivity	Understanding			
	Identify different sources of soil pollution	Applying			
	Describe heavy metal pollution in soil-plant-water system	Remembering			
	Design waste management strategies	Creating			
	Apply remedial measure for soil pollution	Applying			
SS 3101; Soil Biology	Describe soil organisms and their functions	Remembering			
	Identify the beneficial microbes	Applying			
	Describe biochemical processes in soils	Remembering			
	Illustrate the role of soil organisms in improving soil health	Understanding			
	Predict residual effects of hazardous materials and their biodegradation in soil	Understanding			
SS 4203; Project Design and Report Writing	Identify a research gap/research question/problem	Applying			
	Describe the components of a good quality research proposal	Remembering			
	Design a research programme briefly	Creating			
	Write a scientific report/article following appropriate format	Remembering			

Courses	Course Learning Outcomes	Action Verb 1	Action Verb 2	Action Verb 3	Action Verb 4
	Prepare and deliver a powerful presentation on a research proposal or report	Creating	Applying		
	Evaluate a good quality scientific presentation	Evaluating			
	Summarise the findings of a 'climate change and/or food security' related research project carried out at BAU/BARI/BRRI etc.	Understanding			
ENTOM 2201; Fundamentals of Entomology	Explain taxonomic knowledge for classification of insects and arachnids	Understanding			
	Illustrate insects' morphological structures and their functions	Understanding			
	Categorize insects, mites and spiders in different orders and families	Analyzing			
	Discuss physiological, reproduction and neurobiological aspects of insects	Understanding			
ENTOM 2202; Fundamentals of Entomology	Illustrate insects, mites and spiders, and their appendages	Understanding			
	Demonstrate the preparation of temporary and permanent slides of insect appendages	Understanding			
	Explain collection and preservation of insect specimen	Understanding			
	Demonstrate dissection and display of anatomical organs of insect	Understanding			
Entom 3201; Insect Ecology and Pest Management	Provide knowledge on the ecological aspects of insects	Applying			
	Explain monitoring and forecasting pest population	Evaluating			
	Describe , execute and analyze the methods of pest management	Remembering	Applying	Analyzing	
	Design approaches of Integrated Pest Management	Creating			
Entom 3202; Insect Ecology and Pest Management	Identify commonly used pesticides in Bangladesh	Applying			
	Apply precautionary measures during pesticide application	Applying			
	Use different plant protection equipment, traps and baits	Applying			
	Compute pesticide dose, insect population density, and crop yield loss related problems	Applying			
	Describe the common bio-control agents and their rearing	Remembering			
	Design pest management strategies.	Creating			
ENTOM 4101;	Explain the characteristics, life cycle and nature of damage of major field crop pests,	Understanding			

Courses	Course Learning Outcomes	Action Verb 1	Action Verb 2	Action Verb 3	Action Verb 4
Economic Entomology	horticultural crop pests, forest pests, storage pests, and vertebrate pests				
	Execute different pest management strategies	Applying			
	Define and differentiate the insects carrying plant pathogen	Remembering	Analyzing		
	Discuss on industrial insects and analyze the current situations in Bangladesh	Understanding			
ENTOM 4102; Economic Entomology	Identify and differentiate the important pests of field crops, horticultural crops, forest plants, nursery, and stored products	Applying	Analyzing		
	Discriminate the insects carrying plant pathogens	Analyzing			
	Describe different beneficial insects and their rearing techniques	Remembering			
ENTOM 3101; Environmental Entomology	Discuss the effect of pesticide on environment and human health	Understanding			
	Prepare plans for safe use and disposal of pesticides	Creating			
	Construct and design pesticide risk management strategy	Creating	Creating		
ENTOM 4103; Urban and Household Entomology	Accurately identify major groups or species of urban pests	Applying			
	Discuss in-depth knowledge on urban pest biology, behavior, ecology	Understanding			
	Design and apply appropriate pest management strategies for Urban and Household settings	Creating	Applying		
ENTOM 4201; Ornamental and Spice Crops Entomology	Explain the characteristics, life cycle and nature of damage of major insect and mite pests ornamental and spice crops	Understanding			
	Design different pest management strategies for pests of ornamental and spice crops	Creating			
HORT 1201; Fundamentals of Horticulture	Describe the history, branches, importance and scope of horticulture	Remembering			
	Explain the principles and practices including planting methods, raising of seedlings and different intercultural operations	Understanding			
	Apply the skills of different nursery management, pruning, training and propagation practices	Applying			
	Introduce the contemporary new technology in the area of horticulture	Applying			

Courses	Course Learning Outcomes	Action Verb 1	Action Verb 2	Action Verb 3	Action Verb 4
HORT 1202; Fundamentals of Horticulture	Carry out harvest and postharvest handling of different horticultural crops	Applying	Applying		
	Prepare layout of nursery, seed bed and nursery bed	Applying			
	Identify and use of nursery equipment	Applying			
	Practice intercultural operations, potting, de-potting and repotting, pruning and training	Applying			
	Conduct propagation practices of different horticultural crops through rootage	Applying			
	Operate harvesting of different horticultural crops using various methods	Applying			
HORT 2101; Ornamental and Plantation Horticulture	Explain scope, importance; and classify ornamental plants and plantation crops	Understanding	Understanding		
	Describe production and management of flowers, ornamental plants and plantation crops	Remembering			
	Design landscape architectural plan of gardening, roadside plantation and arboriculture	Creating			
	Manage and develop the cut and dry flower business	Analyzing	Creating		
	Identify the ornamental plants and their propagating materials; prepare seed album and herbarium of ornamental plants	Applying	Applying		
HORT 2102; Ornamental and Plantation Horticulture	Conduct propagation practices of different ornamental plants and plantation crops through buddage and other vegetative means	Applying			
	Generate strategies for preparation and packaging of cut flowers for marketing, construct bouquet and design of different flower arrangements, and practice wintering of rose	Creating	Creating	Applying	
	Make bonsai, topiary, grow orchids and cacti, develop graphic design of different ornamental gardens, park and practice roadside plantation	Applying	Applying	Creating	
	Estimate the production cost, predict benefit cost analysis of ornamental plants and process some plantation crops	Evaluating	Understanding	Applying	
HORT 3101; Vegetables	Explain background, status of production and export of vegetable, spices, medicinal and aromatic plants	Understanding			

Courses	Course Learning Outcomes	Action Verb 1	Action Verb 2	Action Verb 3	Action Verb 4
, Spices and Medicinal Plants	Interpret edaphic and climatic factors in vegetable production in reference to climate change	Understanding			
	Illustrate present situation of production, import and export, supply and develop quality seed production strategies of vegetable seeds	Understanding			
	Construct specialized farming	Creating			
	Describe techniques of producing and processing different vegetable, spices, medicinal and aromatic plants	Remembering			
	Identify the vegetable, spices, their propagating materials and outline morphological features of important vegetable, spices and medicinal plants	Applying	Understanding		
HORT 3102; Vegetables, Spices and Medicinal Plants	Estimate the production cost and evaluates benefit cost analysis of vegetable, spice and medicinal plants	Evaluating	Evaluating		
	Practice different intercultural operations related to vegetable production and prepare a report on farmers' field visit	Applying	Creating		
	Extract seeds of different vegetable, determine the quality of vegetable seeds, and estimate seed rate and fertilizer dose for vegetable production	Applying	Evaluating	Evaluating	
	Prepare crop calendar, raise different vegetable and spice crops in plots and write report on these	Applying	Applying	Remembering	
HORT 4201; Pomology	Explain scope, importance, classification, and major fruit growing regions of the world	Understanding			
	Illustrate physiology of flowering, fruit setting, fruit development and production technology of different fruit crops	Understanding			
	Establish and manage fruit orchards and homestead gardens	Creating	Analyzing		
	Interpret physiological and anatomical aspects of vegetative propagation, stionic relationship and micropropagation	Understanding			
	Explain postharvest management strategies of fruits	Understanding			
HORT 4202; Pomology	Identify the common fruit plants of Bangladesh and sketch diagram of morphological features of important fruit plants	Applying	Applying		

Courses	Course Learning Outcomes	Action Verb 1	Action Verb 2	Action Verb 3	Action Verb 4
	Prepare layout of different planting plans for orchards	Applying			
	Practice planting, fertilizing, training, pruning, preparation and application of PGR	Applying			
	Apply different vegetative propagation methods of common fruit plants of Bangladesh	Applying			
	Estimate the production cost, calculate benefit cost analysis of fruits, and determine the quality of fruits	Evaluating	Analyzing	Evaluating	
HORT 3201; Organic Horticulture	Analyze the opportunities, limitations and history of organic horticulture	Analyzing			
	Outline the integrated management systems and issues of organic horticulture	Understanding			
	Describe techniques of soil and crop nutrition management in organic farming	Remembering			
	Interpret the techniques of pest and disease control through biological means	Understanding			
	Develop scopes for recycling organic residues, quality control and value addition of organic products	Creating			
HORT 4102; Postharvest Management of Horticultural Crops	Assess the maturity indices and quality of horticultural commodities through modern techniques	Evaluating			
	Develop improved packaging technologies for transport and marketing	Creating			
	Formulate traditional and refrigerated storage methods for horticultural produce	Applying			
	Demonstrate traditional and chemical methods of ripening	Understanding			
	Prepare various value-added products like juice, jam, canned products, jellies and sauces	Applying			
HORT 4101; Postharvest Management of Horticultural Crops	Analyze the existing status of postharvest management of horticultural crops in Bangladesh	Analyzing			
	Outline the preharvest factors affecting postharvest quality	Understanding			
	Explain different postharvest physiological processes	Understanding			
	Formulate harvesting and postharvest handling strategies	Applying			
	Demonstrate different storage technologies and employ processing and preservation methods to prepare value added products	Understanding	Creating		

Courses	Course Learning Outcomes	Action Verb 1	Action Verb 2	Action Verb 3	Action Verb 4
HORT 4203; Commercial Horticulture	Analyze the agribusiness opportunities of horticultural crops in Bangladesh and formulate seed storage, technology and marketing strategies	Analyzing	Applying		
	Explain the requirements and quality control for export oriented crops	Understanding			
	Demonstrate preparation of value added products	Understanding			
	Describe techniques of year round production of horticultural crops	Remembering			
	Interpret production of crops using organic manures, pest control through biological means and develop scopes of entrepreneurship in horticulture	Understanding	Creating		
PPATH 2201; Fundamentals of Plant Pathology	Discuss basic concept on Plant Pathology	Understanding			
	Explain and illustrate the basic concept of different plant pathogens.	Understanding	Understanding		
PPATH 2202; Fundamentals of Plant Pathology	Demonstrate basic lab techniques on plant pathology	Understanding			
	Prepare microscopic slides	Applying			
	Culture and isolate plant pathogens	Applying	Analyzing		
	Identify the plant pathogens	Applying			
PPATH 3201; Principles of Plant Pathology and diseases of Field Crops	Understand host-pathogen interaction and dispersal of plant pathogens	Understanding			
	Discuss principles of plant disease control and management of field crop diseases	Understanding			
	Identify field crop diseases, etiology and management of field crop diseases	Applying			
	Explain methods of plant disease forecasting	Understanding			
PPATH 3202; Principles of Plant Pathology and diseases of Field Crops	Demonstrate to identify field crop diseases through symptoms study and field visit	Understanding			
	Identify the causal organisms of field crop diseases in the laboratory	Applying			
PPATH 4101;	Discuss detail information on diseases and emerging diseases of fruits, vegetables,	Understanding			

Courses	Course Learning Outcomes	Action Verb 1	Action Verb 2	Action Verb 3	Action Verb 4
Diseases of Horticultural crops and Seed Pathology	cash crops, spice crops, ornamental plants and agroforest trees				
	Explain seed-borne pathogens and their impact on crop production	Understanding			
	Assess crop loss owing to diseases	Evaluating			
PPATH 4102; Diseases of Horticultural crops and Seed Pathology	Demonstrate diagnosis of diseases of fruits, vegetables, cash crops, spice crops and agroforest trees through symptoms study and field visits	Understanding			
	Identify disease causing agents of fruits, vegetables, cash crops, spice crops and agroforest trees thought slide prescription, permanent slide study and writing prescription	Applying	Remembering		
	Explain the detail procedure of different seed health testing methods	Understanding			
PPATH 3101; Clinical Plant Pathology	Describe clinical plant pathology and plant disease clinic	Remembering			
	Explain clinical investigation of plant diseases	Understanding			
	Understand national phytosanitary procedures	Understanding			
PPATH 4201; Post-harvest pathology and food safety	Describe the concept of post-harvest diseases	Remembering			
	Explain detection of post-harvest pathogens	Understanding			
	Illustrate food safety concept ensuring safe food and food security	Understanding			
PPATH 4203; Molecular-Plant Microbe Interactions and Bioinformatics	Discuss molecular mechanisms of host-pathogen interactions	Understanding			
	Explain plant defense responses at molecular level	Understanding			
	Demonstrate different bioinformatics tools to study plant-microbe interactions	Understanding			
CBOT 1202; Plant Morphology	Illustrate the types, characters, modification and functions of roots, stems, leaves, flowers, fruits and seeds of plants	Understanding			
	Explain the descriptors for morphological identification and characterization of crop plants	Understanding			

Courses	Course Learning Outcomes	Action Verb 1	Action Verb 2	Action Verb 3	Action Verb 4
CBOT 2101; Plant Anatomy, Systematics and Economic Botany	Prepare plant herbarium specimens and its preservation.	Applying			
	Show communicative and presentation skills	Remembering			
	Illustrate the structure and function of plant cells and tissues	Understanding			
	Compare and contrast internal structures of field crops	Analyzing	Analyzing		
	Explain embryogenesis, fruit and seed development and in-vitro somatic embryogenesis for crop improvement	Understanding			
	Characterize salient morphological features for plant classification and improvement	Understanding			
	Evaluate economically important plants emphasizing on medicinal, fiber, beverage, sea weed etc., their functions and industrial uses	Evaluating			
	Outline wood formation and apply nanocellulose in agriculture	Understanding			
CBOT 2102; Plant Anatomy, Systematics and Economic Botany	Prepare and demonstrate temporary and permanent slides for microscopy	Applying	Understanding		
	Identify plant cell and tissues, cell organelles, pollen and placenta	Applying			
	Characterize anatomical features of root, stem and leaves of crops	Understanding			
	Apply tissue culture technique for in situ conservation of threatened species	Applying			
	Integrate and apply software and computer aided tools for plant classification and biodiversity management	Creating	Applying		
	Show communicative and presentation skills	Remembering			
CBOT 3201; Plant Physiology	Analyze physiological aspects of water absorption, osmoregulation, water-use efficiency (WUE) and dry matter (DM) production	Analyzing			
	Evaluate photosynthetic pathways, carbon use efficiency, metabolic limitations to DM yield, bio-reduction of nanomaterials and antioxidant properties of pigments	Evaluating			
	Explain energy expenditure during respiration & growth and evaluate modified atmospheric conditions for handling and storability of plant products	Understanding	Evaluating		

Courses	Course Learning Outcomes	Action Verb 1	Action Verb 2	Action Verb 3	Action Verb 4
CBOT 3202; Plant Physiology	Assess radiation use efficiency, growth parameters, assimilate partitioning and yield attributes	Evaluating			
	Outline flowering physiology in relation to photo- and thermo-periodism, application of PGRs on plant growth and development	Understanding	Applying		
	Narrate the causes of dormancy with remedial measures and explain the physiological aspects of osmopriming for germination	Understanding	Understanding		
	Integrate the stress-specific responses of plants with physiological, biochemical and molecular means of overcome and explain auto immune system in plants	Creating	Understanding		
	Analyze water relations in plants to enhance crop production	Analyzing			
	Distinguish among C3, C4 and CAM plants, and integrate their production efficiency	Analyzing	Creating		
	Demonstrate basic phenomena on photosynthesis and respiration	Understanding			
	Separate and quantify photosynthetic pigments under different environmental condition to stabilize food and nutrition safety	Analyzing	Evaluating		
	Examine the influence of different stresses and plant growth regulators on growth and yield of crops in relation to changing climate	Analyzing			
	Perform oral and visual presentation	Applying			
CBOT 4101; Plant Ecology	Discuss ecological impacts and significances of light, temperature, water, wind, physiographic and biotic factors on plant responses for better crop production	Understanding			
	Classify world and Bangladesh climates with crops and vegetation suitable therein	Analyzing			
	Distinguish cultivated and natural ecosystems and biotic association therein	Analyzing			
	Predict the causes and consequences of various pollutions, greenhouse effects, global warming and climate change with adaptation and mitigation strategies	Understanding			
	Integrate knowledge of GIS and remote sensing towards climate smart agriculture for optimization of crop production and resource management	Creating			

Courses	Course Learning Outcomes	Action Verb 1	Action Verb 2	Action Verb 3	Action Verb 4
CBOT 4102; Plant Ecology	Illustrate adaptive features of plants in different habitats	Understanding			
	Explain successional processes, phytogeography and vegetation regions of world and Bangladesh along with forest and biodiversity losses and conservation strategies	Evaluating			
	Illustrate morphological, anatomical and eco-physiological adaptive features of plants in aquatic, xeric, shade and saline habitats	Understanding			
	Demonstrate and explain the different types of biotic relations in agro-ecosystems	Understanding			
	Assess species association and competition within plant communities	Evaluating			
	Analyze community structure and predict vegetation values and stability	Analyzing	Understanding		
	Quantify agro-climatological parameters and interpret plant growth analysis	Evaluating			
	Apply GIS and remote sensing in vegetation study and mapping	Applying			
	Compare and contrast different ecological zones of Bangladesh and perform oral and visual presentation	Analyzing	Analyzing	Applying	
CBOT 3101; Medicinal Plants and Bioresources	Describe the diversity of medicinal plants in Bangladesh and in the globe	Remembering			
	Outline the occurrence, distribution and main categories of constituents of bioresources and bioactive compounds considered to be therapeutic importance	Understanding			
	Evaluate the laboratory techniques for extraction, characterization, purification and related issues concerning the safety and toxicity of medicinal plants and bioresources	Evaluating			
	Apply tissue culture techniques for exploiting value added products development and conservation of medicinal plants	Applying			
	Justify the formulation and preparation of herbal medicine and its phytotherapeutic uses to health promotion and disease prevention	Evaluating			
	Show communicative and presentation skills	Remembering			

Courses	Course Learning Outcomes	Action Verb 1	Action Verb 2	Action Verb 3	Action Verb 4
CBOT 4103; Plant Stress Physiology	Relate different abiotic and biotic stresses which limit growth and development in plants	Remembering			
	Evaluate physiological, biochemical and molecular responses in plants to drought & flooding, heat & cold, salinity & toxic ions, radiation, and biotic stresses	Evaluating			
	Recognize the significance of ROS formation and its role in anti-oxidative defense	Remembering			
	Assess the physiology of plant tolerance to different stresses	Evaluating			
	Interpret different techniques for conducting plant stress research	Understanding			
	Integrate and apply obtaining knowledge of stress physiology for analytical thinking and solving practical field problems experienced in vulnerable ecosystems	Creating	Applying		
CBOT 4201; Plant Biodiversity and Conservation	Describe the status and importance of biodiversity and ecosystem services, and values of biodiversity including sustainable use of natural resources	Remembering			
	Outline the drivers of biodiversity depletion and species extinction and demonstrate the differences among different IUCN red list categories	Understanding	Understanding		
	Formulate current and future conservation strategies for threatened plant species at national, regional and international levels	Applying			
	Discuss current regulation, strategies and economic concerns of conservation, the players involve and their roles	Understanding			
	Evaluate the impact of global climate change on biodiversity and relate ecological knowledge to environmental management practices	Evaluating	Understanding		
	Analyze the biodiversity of different ecosystems using different methods and assess the indicators of measuring biodiversity	Analyzing	Evaluating		
	Show written and oral argumentative skills through paper assignment and in-class presentations	Understanding			
GPB 2201; Genetics	Describe cell organelles of genetic importance	Remembering			

Courses	Course Learning Outcomes	Action Verb 1	Action Verb 2	Action Verb 3	Action Verb 4
and Cytogenetics	Illustrate the structure of different types of chromosome, their function and identification	Understanding			
	Explain chromosomal variation, their meiotic behavior and cytogenetic consequences	Understanding			
	Discuss the Mendelian and non-Mendelian pattern of inheritance	Understanding			
	Explain gene, its structure and function	Understanding			
	Outline the concept and significance of linkage and crossing over, multiple allelism, extra-nuclear inheritance and sex determination	Understanding			
	Discuss the concept of mutation and mode of action of mutagens	Understanding			
GPB 2202; Genetics and Cytogenetics	Prepare slides from plant samples to describe and identify different stages of mitosis and meiosis	Applying			
	Identify the parents, F1 and segregating generations	Applying			
	Explain the pattern of inheritance and variations in segregating generations	Understanding			
	Relate the fitness of field experiment results with Mendelian and non-Mendelian ratios	Understanding			
	Deduce the frequency of crossing over and construct a physical gene map	Understanding	Creating		
GPB 3101; Molecular Genetics & Genetic Engineering	Describe molecular events of DNA replication, RNA and protein synthesis	Remembering			
	Explain events of gene expression and regulation	Understanding			
	Outline the concept and uses of molecular marker and genome mapping	Understanding			
	Discuss the techniques of recombinant DNA technology	Understanding			
	Illustrate genome editing, genetic transformation and their application in agriculture	Understanding			
GPB 3102; Molecular Genetics & Genetic Engineering	Perform DNA/RNA/protein isolation and electrophoresis techniques	Applying			
	Prepare tissue culture media and explants	Applying			
	Outline in vitro plant regeneration from explants	Understanding			
	Demonstrate genetic transformation in crop plants using Agrobacterium	Understanding			

Courses	Course Learning Outcomes	Action Verb 1	Action Verb 2	Action Verb 3	Action Verb 4
GPB 4201; Plant Breeding	Compare advanced and applied research activities at NARS	Evaluating			
	Explain the principles and methods of plant breeding	Understanding			
	Distinguish pollination behavior of crop plants	Analyzing			
	Design conservation and management practices of plant genetic resources	Creating			
	Assess components of population genetics and their utilization	Evaluating			
	Construct and modify need-based breeding strategies	Creating	Creating		
	Illustrate variety release processes and bio-safety issues	Understanding			
	Outline hybridization procedure of different crop plants	Understanding			
GPB 4202; Plant Breeding	Design and execute breeding schemes	Creating	Applying		
	Plan, analyze and interpret field experimental data	Applying	Analyzing	Understanding	
	Assess different plant breeding activities in research institutions	Evaluating			
GPB 3201; Computational Genomics	Outline appropriate bioinformatic tools and databases for genomic data analysis	Understanding			
	Assess bio-molecular properties of DNA, RNA and protein	Evaluating			
	Compose and construct phylogenetic tree	Creating	Creating		
	Interpret structures and interactions of DNA, RNA and protein	Understanding			
	Analyze and interpret omics data	Evaluating	Understanding		
GPB 4101; Plant Tissue Culture	Outline the basic requirements for an ideal tissue culture laboratory	Understanding			
	Describe explant, media preparation and sterilization techniques	Remembering			
	Explain the underlying genetic variations created through plant tissue culture	Understanding			
	Classify different plant tissue culture methods and their applications	Analyzing			
	Define the haploids, double haploids, wide hybrids, somatic hybrids and their use in crop improvement	Remembering			

Courses	Course Learning Outcomes	Action Verb 1	Action Verb 2	Action Verb 3	Action Verb 4
GPB 4203; Innovative Plant Breeding	Describe innovative methods of crop improvement	Remembering			
	Explain the techniques of hybrid variety development in self and cross-pollinated crops	Understanding			
	Analyze methods of creating genetic variation and their uses in plant breeding	Analyzing			
	Assess different seed classes, their production and maintenance	Evaluating			
	Outline intellectual property rights (IPR)	Understanding			
ACHEM 1101; Physical and Organic Chemistry	Describe chemical equilibrium, solubility products, properties of solution and colloids	Remembering			
	Prepare pH, buffer, and standard solutions	Applying			
	Perform volumetric methods for chemical analysis	Applying			
	Explain chemical bond formation, reaction mechanisms and stereochemistry of organic compounds	Understanding			
	Describe aromatic, heterocyclic, carbohydrate, organometallic, polynuclear, carboxylic acid and their derivative compounds	Remembering			
ACHEM 1102; Physical and Organic Chemistry	Choose suitable chemicals and apparatus for analysis.	Remembering			
	Prepare buffer and standard solutions.	Creating			
	Perform titrimetric method of chemical analysis.	Applying			
	Identify organic compounds.	Applying			
ACHEM 2201; Agroindustrial, Nuclear and Natural Product Chemistry	Explain manufacturing, processing, quality control, storage and use of different agroindustrial crops	Understanding			
	Enumerate the chemistry, quality, compatibility, formulations and production technology of fertilizers and pesticides	Remembering			
	Identify suitable radiation detection techniques and justify radioisotope applications in different fields of agricultural research	Applying	Evaluating		
	Categorize water based on quality parameters to recommend water for different usage	Analyzing			
	Deliver concept on sustainable bioenergy generation	Applying			
	Identify the sources and explain purification methods for natural products	Applying			

Courses	Course Learning Outcomes	Action Verb 1	Action Verb 2	Action Verb 3	Action Verb 4
ACHEM 2202; Agroindustrial, Nuclear and Natural Product Chemistry	Operate and calibrate laboratory equipment	Applying	Evaluating		
	Collect and process water, plant and fertilizer samples	Applying	Applying		
	Analyze manures and fertilizers for quality control	Analyzing			
	Determine water quality parameters for different usage	Evaluating			
	Apply radioisotopes in agricultural research	Applying			
	Extract , purify and isolate natural products	Applying	Applying	Analyzing	
ACHEM 4101; Plant Nutrition, Pesticide and Environmental Chemistry	Explain uptake mechanisms and utilization of plant nutrients	Understanding			
	Provide knowledge on chemistry of pesticides with their mode of action	Applying			
	State working principles of major analytical instruments and select suitable analytical techniques for chemical analyses	Remembering	Evaluating		
	Describe the sources, transport, effects, fates and management of pollutants in the environment	Remembering			
	Illustrate the ways of food adulteration; justify the quality control and safety regulations for food products	Understanding	Evaluating		
ACHEM 4102; Plant Nutrition, Pesticide and Environmental Chemistry	Operate and calibrate various analytical instruments	Applying	Evaluating		
	Collect and process plant, food and feed samples for chemical analyses	Applying	Applying		
	Analyze nutrient elements, food adulterants and pesticide residues from different samples	Analyzing			
ACHEM 3101; Bioenergy and Green Chemistry	Explain the scope and importance of bioenergy	Understanding			
	Convert biomass resources to bioenergy	Understanding			
	Apply and compare different sources of renewable energy	Applying	Analyzing		
	Describe bioremediation technologies with their applications	Remembering			
	State the concept of biochar and apply biochar for remediation of contaminants	Remembering			
	Describe the approaches and principles of green chemistry	Remembering			

Courses	Course Learning Outcomes	Action Verb 1	Action Verb 2	Action Verb 3	Action Verb 4
ACHEM 3201; Nanotechnology in Agriculture	Explain nanoscience, nanomaterials, nanotechnologies and background of nanostructures	Understanding			
	Implement the techniques of nanomaterial synthesis and characterization of nanoparticles	Applying			
	Apply nanoparticles in agriculture, food science and environment	Applying			
	State the toxicology of engineered nanoparticles with their environmental fate and transport	Remembering			
	Describe environmental regulation of engineered nanomaterials	Remembering			
ACHEM 4201; Micronutrients in Agriculture	Describe the scope, distribution, forms, biochemical functions, transformation and bioavailability of micronutrients	Remembering			
	Identify critical limit of micronutrients in soils and plants	Applying			
	State the uptake mechanisms and interaction of micronutrients	Remembering			
	Explain the deficiencies and toxicities of micronutrients	Understanding			
	Formulate fertilizer recommendation for overcoming micronutrient deficiencies	Applying			
BMB 1201; Biochemistry and Molecular Biology	Describe scope and importance of biochemistry and molecular biology in agriculture	Remembering			
	Explain biological functions, physical and chemical properties of biomolecules	Understanding			
	Compare, contrast, and interact among various biomolecules in living system	Evaluating	Evaluating	Rembering	
	Construct the structures of various biomolecules	Creating			
	Construct recombinant DNA and clone for developing new crop variety	Creating	Applying		
BMB 1202; Biochemistry and Molecular Biology	Prepare various types of solutions	Applying			
	Identify biomolecules from biological samples	Applying			
	Measure the activity of enzymes	Evaluating			
	Analyze vitamin, moisture, fat, crude fiber and ash from biological samples	Analyzing			
	Extract and estimate starch, DNA and RNA	Applying	Evaluating		

Courses	Course Learning Outcomes	Action Verb 1	Action Verb 2	Action Verb 3	Action Verb 4
BMB 2101; Metabolism and Human Nutrition	Describe digestion and absorption of nutrient molecules	Remembering			
	Explain various metabolic processes (pathways / cycles) with their relationship and energetics	Evaluating			
	Interpret the biochemical function and deficiency symptoms of vitamins and minerals	Understanding			
	Evaluate the food protein quality, BMR, BMI, RQ and SDA according to age, sex, and weight	Evaluating			
	Construct the relationship between nutrition-sensitive agriculture and national nutritional policy	Creating			
BMB 2102; Metabolism and Human Nutrition	Prepare various media for bacteria culture	Applying			
	Characterize fats and oils from biological samples	Understanding			
	Quantify proteins and pigments from plant samples	Evaluating			
	Determine reducing sugar, amino acids, IpH	Evaluating			
	Perform DNA amplification	Applying			
BMB 3201; Applied Plant Biochemistry	Explain cellular compartmentation in metabolic regulation of biochemical processes in plants	Evaluating			
	Describe xenobiotics and secondary metabolites in plants	Remembering			
	Interpret different stress tolerance mechanism in plants	Understanding			
	Analyze agricultural problems with probable solutions	Analyzing			
BMB 4101; Advanced Molecular Biochemistry and Biotechnology	Describe the related terminologies, processes of molecular biology	Remembering			
	Solve enzyme kinetics related mathematical problems	Creating			
	Compare and contrast among various genetic materials	Evaluating	Analyzing		
	Construct rDNA and other related materials of rDNA technology	Creating			
	Apply the knowledge of rDNA technology	Applying			
AF 3101; Principles and Practices of	Describe agroforestry with their characteristics, benefits and attributes	Remembering			
	Categorize agroforestry practices; suggest appropriate agroforestry practices for different land types with suitable Multipurpose Tree Species (MPTs)	Analyzing	Evaluating		

Courses	Course Learning Outcomes	Action Verb 1	Action Verb 2	Action Verb 3	Action Verb 4
Agroforestry	Illustrate tree management techniques and measure tree-crop interaction effect	Understanding	Evaluating		
	Design agroforestry practices for soil fertility maintenance	Creating			
	Analyze cost-benefit and marketing systems of agroforest practices	Analyzing			
	Identify multipurpose trees and shrubs (MPTS) in different categories, their diversified uses and mode of propagation	Applying			
AF 3102; Principles and Practices of Agroforestry	Demonstrate tree-crop management and their possible interactions effects in integrated farming system	Understanding			
	Design and calculate the required material for an ideal forest nursery to raise tree seedlings/saplings	Creating	Analyzing		
	Determine tree growth and calculate its tentative timber volume and price	Evaluating	Analyzing		
	Construct sustainable agroforestry models for different land-use categories	Creating			
AF 3202; Natural Resources Conservation in Agroforestry	Describe plant resources and natural resources	Remembering			
	Determine the biodiversity indices and stand structure of agroforestry species	Evaluating			
	Determine fractional interception of light in different layers and components of agroforestry systems	Evaluating			
	Design agroforestry models for efficient utilization of natural resources viz. light, water and nutrients	Creating			
	Construct appropriate agroforestry programs for biodiversity conservation	Creating			
AF 4202; Social Forestry and Community Development	Describe social forestry, its benefits and historical development in national and global aspect	Remembering			
	Demonstrate in-depth knowledge of collaborative management of forest resources with particular focus on livelihood development of local people	Understanding			
	Analyze international and national polices related to social forestry management and their strategies to community development	Analyzing			
	Design appropriate social forestry programs, and evaluate different people-oriented approaches in the context of Bangladesh	Creating	Evaluating		

Courses	Course Learning Outcomes	Action Verb 1	Action Verb 2	Action Verb 3	Action Verb 4
	Appropriately communicate issues, lessons learned and success stories of social forestry for climate change mitigation in Bangladesh perspectives	Applying			
BTECH 2201; Principles of Biotechnology	Describe different aspects of biotechnology	Remembering			
	Explain basic requirements of tissue culture techniques	Understanding			
	Describe different aspects of recombinant DNA technology	Remembering			
	Apply different molecular techniques in biotechnology	Applying			
	Evaluate safety of GMOs	Evaluating			
BTECH 4101; Applied Biotechnology and Bioinformatics	Apply knowledge of bioinformatics in agriculture	Applying			
	Apply advance knowledge of biotechnology in agriculture	Applying			
	Evaluate biosafety issues of genetically modified organisms (GMOs)	Evaluating			
	Retrieve and analyze genome sequencing data	Analyzing	Analyzing		
ENVSC 1101; Fundamentals of Environmental Science	Acquire knowledge about environment, environmental science and natural resources	Applying			
	Discuss the importance of wetlands	Understanding			
	Describe the benefits and stresses of rural and urban environment	Remembering			
	Explain waste and waste management strategies in urban areas	Evaluating			
	Explain causes and impacts of atmospheric pollution and disaster related hazards	Understanding			
ENVSC 3101; Disaster Management	Discuss foundations of hazards, disasters and associated natural/social phenomena	Understanding			
	Assess the impacts of disaster	Evaluating			
	Familiar with methods of community involvement as an essential part of successful DDR	Applying			
	Familiar with disaster management options	Applying			
ENVSC 4201; Manageme	Define the environment, environmental degradation and environmental management	Remembering			

Courses	Course Learning Outcomes	Action Verb 1	Action Verb 2	Action Verb 3	Action Verb 4
nt of Environment	Identify the causes and adverse effects of environmental degradation	Applying			
	Discuss the principles and methods for assessing and evaluating environmental situations and environmental impacts	Understanding			
	Explain eco-friendly and non-eco-friendly practices for sustainable management	Understanding			
	Discuss about environmental laws, policy and eco-labels	Understanding			
AS 3105; Animal Science	Identify livestock and poultry species and breeds, terminology related to livestock and poultry; analyze animal behavior in farming	Applying	Analyzing		
	Describe housing of livestock and poultry	Remembering			
	Explain about the feeds and feeding of livestock and poultry	Understanding			
	Describe animal ecology	Remembering			
	Discuss behavior and welfare of livestock and poultry	Understanding			
FPM 1151; Farm Mechanics	Identify status, benefits and constraints of agricultural mechanization in Bangladesh	Applying			
	Understand working of different engines and engine systems and troubleshooting of engine	Understanding	Creating		
	Explain different tillage implements, crop establishment and harvesting machinery and postharvest technology	Applying			
	Analyze field and economic performance of different agricultural machinery and cost of simple structure	Analyzing			
	Understand irrigation methods, irrigation efficiency, pump selection and cost analysis	Understanding			
FPM 1151; Farm Mechanics	Identify different engines, agricultural machineries and pumps	Applying			
	Explain different systems of engines, engine's parts, and troubleshooting of engine	Understanding	Creating		
	Understand different tillage implements, crop establishment and harvesting machine	Understanding			
	Understand irrigation pumps and its maintenance procedure	Understanding			
	Identify different types of variable and draw appropriate diagram	Applying	Applying		

Courses	Course Learning Outcomes	Action Verb 1	Action Verb 2	Action Verb 3	Action Verb 4
AAS 3203; Agricultural Statistics	Discuss the measure of location, dispersion and shape characteristics of a frequency distribution	Understanding			
	Illustrate basic terminology, laws and distributions of probability	Understanding			
	Estimate the linear relationship between two variables and execute the testing procedure of hypotheses regarding parameters of the population	Creating	Applying		
	Explain appropriate experimental data and conduct analysis of variance	Understanding	Applying		
AAS 3204; Agricultural Statistics	Identify different types of variable and draw appropriate diagram	Applying	Applying		
	Compute the measure of location, dispersion and shape characteristics of a frequency distribution	Applying			
	Measure the linear relationship between two variables and interpret the coefficients	Evaluating			
	Perform the testing procedure of hypotheses regarding parameters of the population	Applying			
	Conduct analysis of variance (ANOVA) and perform multiple comparison tests	Applying	Applying		
CSM 3101; Computer Science	Acquire basic knowledge on history of computers and generations, basic parts of computers and its uses	Understanding			
	Acquire basic knowledge on computer hardware and software	Understanding			
	Understand the usage of number systems and their conversions and applications	Understanding	Applying		
	Understand topologies, protocols, terminology and architectures associated with both LAN and WAN, including troubleshooting	Understanding	Creating		
	Use programming language to solve basic problems	Understanding			
AGEXT 1201; Fundamentals of Agricultural Extension	Describe the fundamental issues of agricultural extension education and extension work	Remembering			
	Conceptualize the learning theories and laws of learning along with their implications in extension work	Understanding			
	Undertake appropriate initiatives to identify and explain extension teaching methods and aids along with their utilizations in extension work	Applying	Understanding		

Courses	Course Learning Outcomes	Action Verb 1	Action Verb 2	Action Verb 3	Action Verb 4
AGEXT 1202; Skills in Extension Communication	Justify the use of leadership skills in extension work	Evaluating			
	Explain the issues related to motivation in extension work and apply motivation theories in extension work	Evaluating	Applying		
	Explain various aspects of extension teaching methods and aids	Understanding			
	Undertake initiatives to develop the capacity of students to prepare, present, and practice the commonly used extension teaching methods and aids	Applying			
	Construct the ability to use different group techniques in extension work	Creating			
	Acquaint students with agricultural farm and develop the capacity to prepare a report on their outreach activities	Applying	Creating		
AGEXT 3101; Extension Communication and Technology Transfer	Describe communication process, its models, and key elements and their use in extension work	Remembering			
	Conceptualize the concepts of innovation-decision process and explain the use of diffusion process of technologies and adopter categories in extension work	Understanding	Evaluating		
	Explain different approaches of extension work and apply issues of people's participation while preparing and executing an extension programme	Understanding	Applying		
	Describe and apply the concept of group dynamics and partnership issues in extension work	Remembering	Applying		
	Clarify system approaches and agricultural innovation system in extension work	Understanding			
	Justify the importance of partnership in extension program	Evaluating			
AGEXT 3102; Data Collection and Report Writing	Explain different methods of data collection	Understanding			
	Undertake initiatives to develop the capacity of students to prepare an interview schedule/questionnaire	Applying			
	Construct the ability to conduct an agricultural survey, data processing and data analysis	Creating			
	Undertake initiatives to develop the capacity of students to prepare and present a survey report	Applying			

Courses	Course Learning Outcomes	Action Verb 1	Action Verb 2	Action Verb 3	Action Verb 4
AGEXT 4101; Extension Organization Management	Construct practical knowledge of students on research, extension and non-government organization and develop their skill on report writing and presentation	Creating	Creating		
	Explain and characterize different agricultural organizations and personnel involved	Understanding	Remembering		
	Identify and describe the elements of management and associated problems; identify important aspects of organizational decision	Applying	Remembering	Applying	
	Describe the basic concepts of HRM and HRD, explain different types of training, and identify training needs of employees in extension organizations	Remembering	Understanding	Applying	
	Understand and describe important issues of an extension programme	Understanding	Remembering		
	Understand and explain basic concepts, importance and procedures of monitoring and evaluation in extension programmes	Understanding	Understanding		
	Describe rural women, their role in agriculture and extension programmes for their income generation and empowerment	Remembering			
AGEXT 4202; Extension Programme Planning and Field Attachment	Identify and analyze vulnerability issues in agriculture	Applying	Analyzing		
	Identify and explain farmers' problems using participatory methods	Applying	Understanding		
	Prepare appropriate problem tree and objective tree based on identified problems	Creating			
	Identify alternatives and stakeholders of an extension programme as well as prepare alternative chart and stakeholder analysis	Applying	Creating		
	Develop a logical framework in relation to an extension programme and explain how to monitor or evaluate a programme	Creating	Understanding		
	Differentiate between plan of work and calendar of work as well as develop a plan of work and calendar of work of an extension programme	Analyzing	Creating		
	Describe basic concept of training and develop a training schedule for extension program and organize a seminar	Remembering	Creating	Applying	
	Explain the activities of different Nation Building Departments, their coordination	Evaluating			

Courses	Course Learning Outcomes	Action Verb 1	Action Verb 2	Action Verb 3	Action Verb 4
AGEXT 3103; Agriculture and Rural Development	and technology transfer mechanism at upazila level				
	Describe the concept of development as well as agricultural and rural development	Remembering			
	Explain local governments and their functions along with strategies for integrating extension services	Understanding			
	Discuss agrarian structure, land related issues and land utilization trends of rural area	Understanding			
	Conceptualize agricultural transformation and cross-cutting issues of rural development and	Understanding			
	Describe functions of rural development institutions for agriculture and rural development	Remembering			
AGEXT 3201; Application of ICTs in Agriculture	Describe the basic concept of ICTs and e-extension along with its importance, scope and limitations, perceive the role of ICTs in extension work, and explore the current e-extension platforms in Bangladesh	Remembering	Evaluating	Analyzing	
	Conceptualize fundamental issues of web 2.0; describe the benefits and use of web 2.0 tool; and conceptualize the internet ethics and security; develop basic understanding about the design of basic web page and portfolio	Understanding	Remembering	Understanding	Creating
	Develop the understanding of the need and scope of social media in extension service; perceive the principle of social media and risk in it; explore the current initiatives in social media and conceptualize the critical issues of existing content	Remembering	Evaluating	Analyzing	
	Undertake appropriate initiatives to develop the capacity to create content for Facebook and YouTube through mini action research	Applying			
AGEXT 4103; Community Engagement	Describe the basic concepts of community engagement, its importance, scope, principles and limitations	Remembering			
	Conceptualize different stages of community development process	Understanding			
	Undertake appropriate initiatives to develop the capacity to diagnose the needs of the community and develop community-based project	Applying	Creating		

Courses	Course Learning Outcomes	Action Verb 1	Action Verb 2	Action Verb 3	Action Verb 4
AE 1103; Agricultural Economics	Involve students with community development activities	Understanding			
	Explain the nature and scope of economics and agricultural economics	Understanding			
	Illustrate consumers and producers' choices, preferences and behavior	Understanding			
	Discuss theory of market and agricultural marketing	Understanding			
	Explain different functions of banking and insurance	Understanding			
	Evaluate different concepts of measurement of national income, economic growth and development	Evaluating			
RS 1201; Rural Sociology	Analyze the implications of rural sociology in agriculture and rural development	Analyzing			
	Identify and explain different elements of culture	Applying	Understanding		
	Analyze social differentiation, stratification, social class and social inequality	Analyzing			
	Explain the process of agrarian transformation, gender roles in agriculture and rural development	Evaluating			
	Perform social research in agrarian environment	Applying			
LAN 1002; Communicative English	Understand and use a variety of English expressions related to his/ her social, academic and professional lives by participating in routine conversations and fulfilling a variety of speaking functions	Understanding	Applying		
	Apply appropriate pronunciation in speaking	Applying			
	Perform listening tasks through audio-visual tape scripts	Applying			
	Show confidence in making presentations and face interviews in English	Understanding	Applying		

Appendix I: Responses Related to Factors, which Discourage to Use Higher Order Teaching Practices of the Agriculture Faculty at BAU

Exact responses of the survey respondents related to factors, which discourage to use higher order teaching practices of the Agriculture Faculty at BAU are listed as follows:

1. Student characteristics & Subcategories

Subcategories	Exact Responses
More interested in job preparation	• Students are not serious about their academic activities. They are more concentrated on government jobs • Students are demotivated due to job scarcity in the relevant field that makes them reluctant to learn • Students are less attentive to such practices because they do not need to get a good job in government organizations • Student's class performance or semester results/points do not make many differences as to whether they will get a job or not. They better pay attention to preparation for the job even in the beginning of the under-graduation classes • The job market is getting limited in the field of agriculture and mostly job depends on BCS examination and some other factors make students reluctant. Therefore, students are not interested in learning process • Students learning objective/concentration towards job hunting and higher CGPA instead of learning to subject matter; They are mostly interested in the job-related study • Their thinking is to just get a degree and to get a job; Real life learning is difficult here • The students are not serious about their academic activities. They are more concentrated on government jobs • Students are less attentive to such practices because they do not need to get a good job in government organizations • Student's class performance or semester results/points do not make many differences as to whether they will get a job or not. They better pay attention to preparation for the job even in the beginning of the under-graduation classes • Most of the cases, students are not interested taking part in these teaching practices as they find it time consuming and of no use. As they are just trying to grab a job opportunity anyhow • They focused on the certificate and job preparation; Discriminant among the cadre service (Gov. job) makes student inattentive in the class
Lack of motivation in classroom studies	• Students are not well motivated to concentrate in classes • Students are less attentive • Students are not attentive • Students' lack of interest

Subcategories	Exact Responses
	• Students not attentive • Poor interest from the counterpart as they are not interested in classroom or academic activities • Reluctance to learn and engage by the students (lack of interest to learn and invest time) • Sometimes lack of concentration from the students • Lack of students' attention • Lack of students' concentration • Lack of will and concentration from students' side • Limited students’ attention • Lack of attentiveness of students • Low interest of the students • Students are also not motivated to accept higher order teaching and afraid to practice these • They are not well aware of their study in most cases • Students participation timely in the class • Sometimes students try to use his mobile device for Facebook or others • Sometimes it is very much difficult to start new thing against a continuous process. Most of the students like to learn through the lower- order process. As a result, they think higher order teaching process as a complex one • Students are demotivated to learn through modern ways • All students do not understand new concept similarly in same pace and many students of the class yawns and looks out the window while some understand clearly • It is more difficult to improve thinking ability of students because of the motivation in class • Students are reluctant in higher order learning • Students' attitudes to learning • Both the students and teacher are not ready to follow the higher order: as we have been accustomed with previous method of teaching • Less students are willing to participate the brainstorming session. They are in hurry for ending of the class. For this sometimes it becomes a tough job to create some brainstorming session • Sometimes it is very much difficult to start new thing against a continuous process. Most of the students like to learn through the lower- order process. As a result, they think higher order teaching process as a complex one • Students are not willing to invest their time in critical thinking: They just need token to pass the exam • Students do not get interests on the subject as they think that the study is for degree not for learning • Usually students are reluctant in learning because of many socio-economic conditions

Subcategories	Exact Responses
	• Communication and presentation skill are not satisfactory • Physical strength of the students • Different quality students • Students are not willing to read manuscript and book related to topic and only they want to copy and paste from Internet when I provide them assignment
Lack of time for self-study	• Sometimes students could not get enough time to solve the problem due huge load of courses from different departments
Huge credit hours load and course requirement for the students	• Over credit loads both on the teachers and students • Course content is too huge to finish within allocated schedule • Big flocks in a classroom and huge course load might be the real challenge for implementing the higher order teaching practice
Faulty job examination system	• Challenges in motivating the students to learn and respond to higher order teaching practices. It is far more difficult than the first challenge because all the public exams for job recruitment require plenty of memorizing. Students spend much more time to prepare for those public exams during the 4 years of graduation at universities and are not interested to gain in-depth disciplinary knowledge • The education system and job market focus more on getting higher grades than learning which distracts the students from proper learning interests • The job market is getting limited in the field of agriculture and mostly job depends on BCS examination and some other factors make students reluctant. Therefore, students are not interested in learning process

2. Faculty Characteristics & Subcategories

Subcategories	Exact Responses
Lack of training	• Lack of Training • Training facilities related higher order teaching practices • There is no such training for teachers through which they can learn how to apply higher order teaching methods • In most cases the teachers lack in adequate training on effective teaching learning • Inadequate training for the teachers on higher order teaching practices • Lack of proper training of teachers • We do not have enough facilities (especially technical facilities, lack of training, etc.) • It is difficult to monitor individual student of a large group in one class • The size of the class is too big to contact, monitor and taking feed-back both in the theoretical and practical classes

Subcategories	Exact Responses
	• Higher order teaching practices involve close supervision of the teacher for every student • Teachers require more practice • I also need more practices to develop my high order thinking skills and its applications in my class • Matchless situation is in between learning attitude of students and lectures of faculty • The physical demonstration is a real challenge
More involvement in additional activities	• They are interested to be involved in political activities rather than be involved in teaching • Lack of leadership
Lack of incentives	• Need more fund and facilities • Lack of incentive in the system for both the students and I
Unreadiness to follow higher order teaching practices	• Senior teachers are not actually well interested during the question set • Formation of higher order questions for class test/final exam, the senior teachers of the department did not accept it fully • Most of us still rely on traditional teaching methods • The traditional teaching-learning system is the main challenge • Most of the people do not practice higher- order teaching: So, students find it hard to practice sometimes
Lack of freedom to follow higher order teaching practices	• A teacher has no freedom to practice higher order teaching practices. He/she has to follow the rules and process, determined by the authority

3. Classroom Environment and Subcategories

Subcategories	Exact Responses
Inappropriate classroom environment	• Classroom physical facilities lacking such as noisy • Classroom environment is not suitable in many cases for both theory and practical classes • Classroom arrangement • Lack of enabling environment, for example- standard classroom environment • Lack of standard classroom • Sound echo
Huge number of students per class	• Classroom environment is not up to the marks, means number of students very high • Bigger class size • Large class size • Big classrooms with around 100 students in each class for theory lecture • Class size in theory is around 100 and in practical classes is 35, which is the major challenge to use more higher order teaching practices

Subcategories	Exact Responses
	• Class size is big • Class size large: 100 students • Due to high number of students in each class (100 or more): It is sometimes difficult to conduct whatever I want in higher order teaching practices • Huge number of students in the class • Huge number of students • In the theory lecture, number of students are higher, so difficult to reach each and every one • Large number of students • Large number of students • Large number of students in a class • Larger class size • More students in a classroom • Number of students are higher to manage • Number of students are more compared to facilities provided for • Number of students are quite huge in my classroom • Number of students in a class is much higher than the optimum level • Number of students per class is more than average • The huge number of students in the class. So, discussion and problem-solving efforts are a bit limited • The size of the class is too big to contact, monitor and taking feed-back both in the theoretical and practical classes
Classrooms are not well-furnished and well equipped	• Not well furnished • Classroom is not well equipped • Lack of proper facilities in the classroom • Lack of sound system • Less equipped • Lack of proper instrument • Basic technological problem, e.g. Sound system problems, multimedia projector deficit in practical classroom • Lack of advanced laboratory • Poor lab facilities unable to attract curious student for better learning • Lack of advanced laboratory • Inadequate physical facility • Not enough facilities available • Lab/ classroom facilities • Sometimes there is a lack of the adequate classroom facilities • Limited space • Lacking advance research equipment for students to practice • Sometimes lacking Electricity supply so cannot display Power point lectures • Load shedding while running classes

Subcategories	Exact Responses
	• Low speed internet • Lack of internet facilities in the classroom
Limited lecture sessions	• Limited time to get feedback from students • I face multifaceted challenges to use more higher order practices for time bounded classes during teaching and learning sessions • I face multifaceted challenges to use more higher order teaching practices for time bounded classes • Limited time • Shortage of time • Sometimes fails to accommodate the class within 2 hr. practical • The time constraints of class and tightly packed semester schedule leave small room for more higher order teaching practices • Time allocation for a session (one hour in theoretical sessions) • Time limitation • Short class duration: Only 55 minutes • The use of higher order teaching practices develops students' higher order cognitive skills in classes are not enough in class hours" • Class schedule creates overload situation • Less contact hour: The academic schedule and actual schedule is not the same • The lecture period is short

4. Teaching Resources and Subcategories

Subcategories	Exact responses
Lack of modern teaching aids and facilities	• Lack of teaching aids • Lack of teaching aids and facilities • Limitations of modern teaching aids • Limitations of modern teaching aids • Lack of teaching aids • Lack of teaching aids and facilities Basic technological problem, e.g. sound system problems, multimedia projector deficit in practical classroom
Lack of appropriate class materials	• Lack of teaching materials • Sometimes, it is very difficult to find appropriate class materials to that matches the content of topic and can take hours and hour • All teaching materials are not available • Lack of teaching facilities and materials • Lack of teaching materials • Lack of teaching facilities and materials

	• Limited access of latest information • Lacking availability of IF [Impact Factor] Scientific articles related to topics;

5. **BAU Tradition and Subcategories**

Subcategories	Exact Responses
Rigid curriculum for classroom teaching and evaluation system	• Most of the students initially do not ready to accept higher order teaching practices as they are habituated with the traditional closed book examination systems at the Bangladesh Agricultural University (BAU) • Exam and evaluation system need to be revised • Existing rules of the university especially for examination willingness of the students • Existing university policy for exam system is not consistent enough (or encourage) to implement high order teaching system • The main problem is the overall exam systems for the university • The course, curricula and evaluation system of higher education do not allow me to use more higher order teaching practices in my classes • Present curriculum, assessment procedure, and teaching-learning environment are not friendly enough • Present curriculum, assessment procedure and teaching-learning environment are not friendly enough • Our Undergraduate education systems do not have enough room (single class teacher) to apply the higher order practices • However, in MSc level I can practice it partially. I mean no scope (BSc) for assignment, plenary discussion, recent publication discussion, open ended questions, etc. • Challenges in developing an updated and interesting curriculum • Lacking market-oriented syllabus • Difficulties to take several exams during semester period
The nature of the subject or courses	• The nature of my subject/course limits the scope of too many higher order teaching practices • The topics are more theoretical rather practical oriented • Sometimes it is quite impossible to ask high-level open question
Limited semester duration	• Short time period for a semester • Course content is too huge to finish within allocated schedule • Limited time • Shortage of time

Subcategories	Exact Responses
	• The time constraints of class and tightly packed semester schedule leave small room for more higher order teaching practices • Time limitation
Lack of community motivation	• Lack of community motivation towards updated methods • Problem solving and societal involvement
Political constraints	• Political constraints
Low students-teacher ratio	• Low students - teacher ratio

Appendix J: Responses Related to Factors, which Encourage to Use Higher Order Teaching Practices of the Agriculture Faculty at BAU

Exact responses of the survey respondents related to factors, which encourage to use higher order teaching practices of the Agriculture Faculty at BAU are listed as follows:

1. **Student Characteristics and Subcategories**

Subcategories	Exact Responses
Improves creativity and critical thinking abilities	• Students will be more creative • Encourage students for creative thinking • It might encourage creative thinking • Higher order teaching methods will improve their creativity • The students will become more creative thinkers and better problem solvers • To encourage creative thinking • The students will become more creative thinkers and better problem solvers • Critical thinking • Develop critical thinking of students • Students would learn on how to think instead of what to think • Should be improved "how to do" learning process • Higher order teaching practice is a way to help students think and not just memorize • Students can make critical interpretations, draw relevant and insightful conclusions using their own background knowledge • Improving thinking ability helps to get more insights in a specific area • Critical thinker; Students can increase their critical thinking capability • Using higher order teaching practices, I can recognize the student’s ability to think critically • Student can critically think and analyses the content in their own way • It enhances the ability and skill of the students for critical thinking and resolving the real-life problems • It helps the student to improve their thinking and problem-solving ability by critically analyzing complex problems or situations • Students can think and execute independently; Student can draw relevant and concrete conclusion
Improves real world problem-solving skills	• They will think critically and solve their problem by their own • Critical thinking skill on problems solving are developed

Subcategories	Exact Responses
	• It helps the student to improve their thinking and problem-solving ability by critically analyzing complex problems or situations • It enhances the ability and skill of the students for critical thinking and resolving the real-life problems • Students can think and execute independently • They will think critically and solve their problem by their own • Real world problem solving • Students can be capable of solving the problems in real life situation • Moreover, students can use their knowledge in practical life after completion of study • Enable students to brainstorm for troubleshooting a real-life problem • Real-time problem-solving learning • They can link between theory and real-life problem-solving techniques • Helps students solve problems in practical situation • Students will be capable in solving real-life problems • Students become confident in solving unseen problem, which would be more effective for being competitive graduates • It enhances the ability and skill of the students for critical thinking and resolving the real-life problems • It helps the student to improve their thinking and problem-solving ability by critically analyzing complex problems or situations • The students' problem-solving skills will be improved, and they will perform better at their job sector • Problem solver • To teach students to use a step-by-step method for solving problems • Analyze the situations • Students can apply the knowledge they acquired, analyze, and evaluate what they know • Students can identify their problem easily • Students get the opportunity to participate in real learning through doing by their own • Students prepare themselves for their real life • New idea comes out through analysis and critical thinking • Students can generate new idea, solve problems by themselves • Make the student able to use their knowledge in new situation • They can link between theory and real-life problem-solving techniques

Subcategories	Exact Responses
Improves attentiveness and understanding	• Students are more attentive to class and understand class easily, grow leadership ability, interested in teamwork, and enrich their thinking level • I believe that higher-level teaching practices in Bangladesh will improve the participation and interest of at least 20% of students in academic activities • Improve students' level of concentration and degree of understanding in the classroom • More attentive • Students become more attentive • Students get more attentive • Students will be more attentive in the class • Students are more attentive to class and understand class easily, grow leadership ability, interested in teamwork, and enrich their thinking level • Students are more focused on subject matter • Students attachment • Some of the students are really interested in learning by doing • Concepts become clearer to students • Increases students understanding • It helps students to understand more easily • Students will be able to understand the subject • Using more higher order teaching practices help the students understanding higher levels of the facts, infer them, and connect them to other concepts rather than just memorizing • Easy to understand • Help develop clear concept with in-depth understanding Improve students' level of concentration and degree of understanding in the classroom • It provides me with the better understanding of how I should carry my teaching methods in favor of students • Using more higher order teaching practices help the students understanding higher levels of the facts, infer them, and connect them to other concepts rather than just memorizing • Students can learn the concept in the discussion place; Students can make critical interpretations, draw relevant and insightful conclusions using their own background knowledge • It allows the students to think about the topics more practically • It increases the students view and knowledge to a specific issue • This changes attitude within the students about the new and advanced way of teaching at BAU

Subcategories	Exact Responses
Improves leadership skills	• Students are more attentive to class and understand class easily, grow leadership ability, interested in teamwork, and enrich their thinking level • Develop leadership and collaborative learning atmosphere • Leadership development • Students are more attentive to class and understand class easily, grow leadership ability, interested in teamwork, and enrich their thinking level • Students have to be ambitious • Students are more attentive to class and understand class easily, grow leadership ability, interested in teamwork, and enrich their thinking level • Group discussion • Students become confident in solving unseen problem, which would be more effective for being competitive graduates • In future students can take challenges to make them solve • Students become confident in conducting work independently • The confidence level of students is higher • Increase confidence level of the students • Makes students self-confident and empowered
Increases education and learning effectiveness	• Effective learning at the students' levels • If it is possible to use more higher order teaching practices definitely it will help students to learn • Its more effective; Students can learn a thing very effectively • Very effective for learning • More fruitful teaching and learning • Improve students' cognitive ability • Improving learning outcomes • To achieve more retain capability of the students about the topic he/she learnt • Lifelong learning • Scope to learn increases • Learning outcomes can easily be achieved • Student can create knowledge in their own way • Interactive teaching help students to enrich their knowledge • Knowledge will be enhanced • Quality education • Overall level of education will be increased • Education and research will be more advanced and improved • Only some of students fell better • Lower categories students will be more benefited • If they are engaged once, they find it interesting

Subcategories	Exact Responses
	• It will help the students to get back their interest in learning • Students feel interest in learning • It helps students to bring their attention in to study • Students are happy to learn in the class. They say they do not need to more study at room, they are enjoyed • Students centered learning • More interests • Students enjoy it because they do not feel pressure to memorize anything; Students interest • Student build and strengthen their presentation and writing ability • Student dependency on fixed note/text/handout will be dissolve • Students will be enriched with new technology and innovation • To encourage questioning in a classroom where students feel free to ask questions without any negative reactions • Knowledge and skills obtained by the students can be assessed very effectively • Exam results is very satisfactory and teacher himself feel very happy and satisfy to use the method Helps in job exam too

2. Faculty Characteristics and Subcategories

Subcategories	Exact Responses
Increases teaching efficiency	• It will increase the efficiency of teaching learning process by increasing the involvement of both teachers and students in the knowledge flow • More fruitful teaching and learning • It will help us to think differently and teach the student at a standard level • Increased standard of teaching • Its saves time and more effective to deliver lecture • I find the confidence that students have learned the topic that I intended to because I can anticipate the progress • Engaging teaching style • Exam results is very satisfactory and teacher himself feel very happy and satisfy to use the method • Students feel ease when I use student focused teaching-learning process • It provides me with the better understanding of how I should carry my teaching methods in favor of students

	• It will increase the efficiency of teaching learning process by increasing the involvement of both teachers and students in the knowledge flow • Power point lecture • The teachers will also be dynamic in gathering knowledge from updated literature and sharing the knowledge to the students. This will ultimately help improving the learning environment • Students are interested to know the advanced information that real life-based requirements, which I try to bring as examples in my lectures and supply them some related articles • This allows teachers to identify the students who needs mentoring and plan accordingly • Taking class with large of students • Good harmony between teacher and student • Class will be more communicative and live through using higher order teaching practices rather teacher centered learning • Interactive learning • Interactive learning helps engaging students in the discussion • Lectures become more participatory; Students get more engaged • More areas of syllabus may be covered within the specified time schedule • Good feedback • Teachers can also get feed-back of delivering his courses and his teaching strategies

3. Classroom Environment and Subcategories

Subcategories	Exact Responses
Creates better classroom environment	• Better teaching-learning environment created • Class will be more communicative and live through using higher order teaching practices rather teacher centered learning • Develop leadership and collaborative learning atmosphere • Lectures become more enjoyable • The classroom environment will be good both for teachers and students • Students' interactions increased
Saves lecture times	• Its saves time and more effective to deliver lecture; Time saving
Helps to maintain the semester schedule	• It will maintain the semester schedule

Helps students to get up-to-date information in classroom	• Students can get up-to-date information in a particular course

4. National and Institutional Benefits and Subcategories

Subcategories	Exact Responses
Helps to create quality graduates	• Quality graduates • Students will be more qualified to compete • Higher order teaching practices actually very important in developing skill in the students • Quality graduates will produce with field-based knowledge • Without using more higher order teaching practices tertiary education is meaningless. National growth in education sector will be practically impossible. At the same time, research area will not be competitive in the global market. Finally, national growth may be unsustainable
Helps to national growth	• Higher competencies of the students in the global industry • Students will be more qualified to compete. Finally, our university will be topper in world ranking • It is a time demanding process. To develop a country, nation, creativity is very much essential point. So, if we want to teach and judge a student perfectly higher order teaching practices is necessary for us • Without using more higher order teaching practices tertiary education is meaningless. National growth in education sector will be practically impossible. At the same time, research area will not be competitive in the global market. Finally, national growth may be unsustainable.
Overall education and research will be advanced	• Education and research will be more advanced and improved • Students will be more qualified to compete. Finally, our university will be topper in world ranking
Time demanding process to develop a country	• It is a time demanding process. To develop a country, nation, creativity is very much essential point. So, if we want to teach and judge a student perfectly higher order teaching practices is necessary for us • Without using more higher order teaching practices tertiary education is meaningless. National growth in education sector will be practically impossible. At the same time, research area will not be competitive in the global market. Finally, national growth may be unsustainable.

Appendix K: Responses Related to Recommendations of the Agricultural Faculty Members at BAU to Create Higher order Teaching Practices

Exact responses of the survey respondents related to the recommendations to create higher order teaching practices at BAU are listed as follows:

1. Faculty Characteristics and Subcategories

Subcategories	Exact Responses
Include more group-based assignment, presentation, reading assignments, demonstration, hands-on practical works, and field trips	• Reading assignment should be included in lecturing system • Students should give more exercise in classroom • Need to include assignment, essay writing, project works for every student in their course work and finally the student will present those in the plenary sessions (carry marks) • Motivate students to participate in group studies • Classroom based teaching should be improved which should include more group approaches and problem-solving assignment/tasks to replace/reduce number of exams • Group discussion and small project work should be included in each undergraduate degree • Motivate students to participate in group studies • Presentation skill should be improved by arranging frequent group discussion • Presentation, group study, brain storming, field travelling should be practiced and materialized in all the departments of Agriculture faculty • Students should engage with more group works and assignments in theory class • Need to arrange Field visits for relevant topics • Presentation, group study, brain storming, field travelling should be practiced and materialized in all the departments of Agriculture faculty • Presentation skill should be improved by arranging frequent group discussion • Classroom based teaching should be improved which should include more group approaches and problem-solving assignment/tasks to replace/reduce number of exams
Arrange advanced training programs	• Proper need-based training and workshops for the faculty members to inspire them to use higher order teaching practices more effectively • Arrange different training provide all of the modern facilities • Arranging training programs for all academic members of our faculty • Both the students and teachers required practical hands on in handling higher order of teaching practices

Subcategories	Exact Responses
	• More training facilities should be provided for the faculty member regarding higher order teaching practices • Motivational training and linkage between academics and real life should be prioritized • Need proper training to faculty staff • Need to provide training to the teachers or need to arrange a seminar to encourage about the higher order teaching practices • Proper need-based training and workshops for the faculty members to inspire them to use higher order teaching practices more effectively • Provide intensive training to the teachers • Teachers and instructors need to be well trained and equipped to conduct the higher order teaching practices • Teachers need more training • Teachers should be trained up • Teacher's training • Teaches should be provided with extensive training on higher order teaching practices • The university should coordinate routine training events and ensure that all professional trainers are employed • Train the faculties • Training for teachers on higher order teaching practices • Training should be provided on higher order teaching practices
Creates more congenial atmosphere in classrooms	• Teachers should be more friendly to them so that students can share any ideas without hesitation • Encourage student-teacher interactive learning process through active participation of both • We have to improve our knowledge and skill in it • Both the students and teachers required practical hands on in handling higher order of teaching practices • Use of enterprising teaching methods • We need to follow appropriate teaching methods • We should follow the higher order teaching practices strategy in the classroom • Invest more on student centered method for supplying material • Student centered based teaching and learning should be practiced • Some of the existed trend of writing practical notebook or other unnecessary practices should be omitted • Removal of practical khata (assignment) writing • To create an outcome-based learning strategy, we must follow higher order teaching practices in the Agriculture Faculty of BAU

Subcategories	Exact Responses
	• Teacher wants their students to create higher order teaching practices. Higher order teaching practice takes thinking to a whole new level. Students using these practices are understanding higher levels rather than just memorizing facts. They would have to understand the facts, infer them and connect them to other concepts. Higher order teaching practice requires students to really understand a concept, not repeat it or memorize it. This practice encourages students to elaborate their answers by asking the right questions • Results should be published online in time; Examination system should be digitized
Ensure accountability	• Ensure accountability • Sincerely of the teachers • Research based activities need to increase • Introducing self-teaching assessment • Faculty should develop a strategy and monitor that higher order teaching is practiced • Evaluation and monitoring system of higher order teaching practices • Include teacher evaluation system
Follow recommend textbooks and provide class notes	• Should follow recommend textbooks and made them available in the library • Class notes • Motivate students to read textbooks, journal articles that are provided in their course references
Follow Bloom’s Taxonomy in classrooms	• Learning staircases should be incorporated properly in the study • Teachers need motivation and complete knowledge of Bloom's taxonomy • We can follow Bloom's taxonomy to promote higher order thinking • We can use Bloom's taxonomy to promote higher order thinking
Change mentality of teachers	• Teachers must consider the students' abilities in the classroom by choosing interesting topics in the class • BAU teaching community should be concentrate towards academic activities • Change of mentality of teachers too • The question set should be in higher order • Stop teacher politics •

2. BAU Tradition and Subcategories

Assessment method should be improved	• Assessment method should be improved • Assignment and presentation based evaluation in theoretical classes; Changing test procedure • Changing the examination and evaluation system • Evaluation system should be changed • For this the course, curricula and evaluation criteria also need to be updated • More Quiz exam; Pass marks should be 50% (and below 80% marks in a specific subject will lead students to attend the exam once again) • Rearrangement of score allocation (for theory courses, now 90% marks are allocated to written examination. There are no marks for home assignment, group works and classroom activities (this should be done instead of attendance) • Revised test/exam/evaluation system; Student grading system of BAU should be revised i.e. student pass marks must be 50% • Surprise exam • The evaluation system currently in place at BAU should be modified • The university also needs to refine existing examination and evaluation systems • Update the evaluation process • We have to change our question and answering systems, in this open ended or open book exam can help with critical questions • As most of the exams in S.S.C and HSC are creative, so, in the universities we should practice it more to make students active and critical thinkers. Therefore, they will not find this system hard
Course curricula and syllabi should be revised	• Classroom based teaching should be improved which should include more group approaches and problem-solving assignment/tasks to replace/reduce number of exams • Course curricula and student assessment system should be revised • Reduction of total credit hours Inclusion of more sessions on life making courses that develop their graduate profile • BAU should revise the syllabi of the course content from different departments and reduce the backdated information, which are already recognize as fact. BAU just revised and reduced the course credit but not the syllabi at all • Change the curricula and syllabus in terms situation demand • Curriculum needs to revise based on practical need; Improved course curricula

	• Making curriculum more psychomotor and affective based contents (now too much lecture centered) • Modification of syllabus • Need more advanced field-oriented curriculum • Recommendation: Need update course curricula in which the project works/essay/assignment will be included as a part of the course work • Update course-curricula based on field problem and job market • Update syllabus • Need-based Syllabus • The most important one is the higher authority. They should have to concern about it and need to take the necessary steps • We need to have outcome-based course curricula for the students • Market oriented education; Change in academic policies that will encourage high order teaching assessment system • Reducing course load • Course contents should be reduced judicially, Only few basics with more applied topics should be added • Drastic reduction of course content • Reduction of course load for theory classes • All students should have internship experience for making themselves perfect to get the job in government and non-government organizations or even they would have the opportunity to prepare themselves as an entrepreneur
Change job-exam system	• Better job placement; Help in subjected oriented job placement • Request to the national level policy makers to emphasize on the subject matter knowledge while recruiting for the job • Create public private partnership for saleable product development • Link between BAU and other universities in the globe
Reduce overall political pressure	• Need to reduce overall political pressure to the administrative authority; The university should create politics free learning environment
Implement students counselling system to improve mental health	• There should be some student advisors to consult with small group of students this should cover the students' mental health and wellbeing or stress management those are completely ignored in our country
Monitoring and evaluation for teaching and evaluation approaches	• Dean/ one selected teacher may evaluate the question status of all the departments and the lacking should be presented to all the teachers • To enhance higher-level teaching practices, I believe that the University should periodically review each department with regard to the specific academic activities assigned to them

	• Identify problems of the teaching process and take initiatives to solve them immediately
Enhance students' facilities in all stages	• Enhanced students' facilities in all stages
Implement student-based teachers' evaluation system	• Student's judgement also needs to be done by this process
Assure dignity of the meritorious students	• The meritorious students should be honored in every sphere of the society • There should be system so that good students will be able to get into job market
Provide more incentives for teachers	• We need to provide incentive for better teaching-learning outcomes • Resource allocation is mandatory, so that teachers will not feel de-motivated to do so

3. Classroom Environemnt and Subcategories

Reduce number of students per class	• Classroom size should be reasonable that teacher can handle the students properly • Classroom size should be reduced to enable practicing higher order teaching practices • Consider the classroom size, also students' number • Less students (not more than 50 students in a section) • Need to improve class size (maximum 40 students in a class) • Need to reduce students' number both theory and practical classes • No. of students in both theory and practical classes should be minimized • Number of students in each theory class should be around 60 to allow more room for interaction • Number of students per class should not be more than 50 in theory classes and 20 in practical classes • Number of students should be assigned according to facilities provided, and vice versa • Number of students should be less in each section for theory classes • Optimize the number of students in each classroom • Practical group should be within limited number of students • Reduction of student number in a single theory and practical class • Should maintain a suitable number for maximum student in a single class • Size (number of students) of both theory and practical classes should be reduced • Small and manageable class size; Small class size • Small class size

	• Student number should be decrease in each classroom. I recommend it should be not more than 50 each class • Students size • The number of students should be decreased both in the theory and practical classes to deliver information in a more effective way • The points to be considered- ensure small class size; To develop adequate classroom numbers with optimum students • We should minimize the class size
Classroom should be well furnished and decorated with modern equipment	• Classroom should be well furnished and decorated with modern equipment • Classrooms should be equipped with modern facilities • Improve physical facilities of both theory and practical classes • Latest classroom technology • Physical facilities should be increased in the classroom • Provide adequate classroom facilities • University should re-innovate the classroom to boost the learning environment • Adequate research equipment should be provided
Make congenial classroom environment	• Need to create a congenial physical environment in the class along with modern facilities • Classroom environment should be made convenient to both teachers and students • Classroom environment should be strengthened, i.e. physical environment is important • Congenial environment both in classroom and student residence • To ensure congenial atmosphere for the teaching, establish standard classroom, updated rules and regulations of teaching like a world class university for instance VT • Actual study environment needs to provide in classroom and specially in the students' residential halls • Congenial environment both in classroom and student residence • Making easily affordable to usage of different ICT tools in the class • Wi-Fi facilities should be ensured in the classroom • Create good environment (no noise of fan) or try to accommodate air condition in the classroom
Lecture period needs to be re-scheduled	• Theory and practical classes should be proportionately emphasized; The lecture period needs to be re-scheduled; The length of a class should be increased to at least one and half hour
Increase teacher student ratio	• Number of students per teacher should be optimized; Manageable teacher student ratio

4. **Teaching Resources and Subcategories**

Include digital learning management systems	• Digital platform for teachers and student's interaction
Provide available teaching resources	• Available teaching materials • Better facilities of teaching instruments in the classroom and equipment in the labs • Modern teaching tools • Relevant and up-to-date teaching materials for the students to make them curious about the concept • Teaching materials should be made available • More standard Lab facilities should be provided for effective teaching • Improved lab facilities • Supply logistic supports to the classroom • Every technological problem should be addressed and solved as soon as possible
Provide financial supports to develop new teaching materials	• Financial support to be provided when necessary to make the university center for excellent in regard to higher order teaching practice
Provide teaching and research assistantship	• Provide teaching and research assistantship for post-graduate students

5. **Student Characteristics and Subcategories**

Rules and regulations about students' behavior and discipline should be updated	• Rules and regulations about students' behavior and discipline should be updated
Change students' mind-set	• First make the students understand that they need to learn something in their courses to get a good job through making the job market more competitive not by color or other means but by merit • I think learning by doing is one of the best approaches to make our students efficient. They should be encouraged to involve themselves in different research activities from their graduation level