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Course Facilitators' Teaching Approaches and Challenges: Inputs to the Development of an Issue-Based Instructional Model in Science Technology and Society (STS)

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Abstract: This study aimed at determining the course facilitators' teaching approaches and challenges as inputs to the development of an issue-based instructional model in Science Technology and Society (STS). This involved 38 STS course facilitators from the different State Universities and Colleges (SUCs) in Panay Island and 67 STS students. The development of the issue-based instructional model utilized the modified ADDIE model. The statistical tools employed were mean, standard deviation, and frequency count. The STS course facilitators used audio-visual aids and other printed materials in delivering the lesson and mostly through lecture demonstrations. Some challenges they encountered are their feeling of inadequacy to teach the course, scarcity of updated learning resources, and lack of skills in motivating students who have no scientific inclination. It could be concluded that there is a prevalence of the use of visual materials in the STS classroom. Also, concretizing the science concepts and relating them to real-life situations is an integral part of STS instruction. Some course facilitators are not academically prepared to handle the course. Students do not develop their critical thinking skills. The developed issue-based instructional model and the course syllabus in STS promote convenience in the teaching and learning of the course.
Keywords: Teaching Approaches; Teaching Challenge; Issue-based Instructional Model; Science Technology and Society

Background of the Study

Science Technology and Society (STS) is one of the general courses offered across different programs in the revised curriculum of the CHED which started during the full implementation of the K to 12 programs. One of the goals of general education as articulated by the Commission on Higher Education (CHED) is to create responsive graduates equipped with the competency to learn continuously throughout life (CMO No. 20 series of 2013). STS education promotes and encourages students to critically examine scientific issues from an analytical perspective and learn how to acquire, comprehend, and evaluate scientific knowledge (Autieri, Amirshokoohi, & Kazempour, 2016).

In the global context, conflict was found between students' and teachers' respective abilities to know the content of STS and to speak this contenteffectively. Teachers have difficulties in understanding STS and implementing it in an exceeding fashion per their students' interests. Students as well have difficulties in their comprehension of the content and the process(King, 2007). In the Philippines, instructional strategies in STS give students little opportunities to explore and maximize their full potential in creating solutions to some of the most pressing societal issues related to science. The engagement of the students in constructing their knowledge is very slim. Higher education institutions (HEI) are turning out graduates and professionals who are detached from many socio-scientific

issues, hence they are easily swayed by the so-called "fake news" that proliferates social media. This is very evident during this time of the pandemic where many are misguided by wrong information circulated on social media about the virus and the anti-virus vaccines. In the region, teachers teaching STS lack the expertise to properly introduce and teach STS courses to the students. Besides, some most effective strategies require innovative teaching skills that go well beyond just dispensing information (Mansour, 2007). However, the researcher finds the topics in the present course syllabus not well-organized and each topic is treated differently, starting from the discussion of the general concepts and STS historical developments, followed by STS and the human condition, and lastly specific issues in STS. This would recognize the urgency of addressing issues and gaps in attaining quality education. Currently, there is no instructional model developed to guide the course facilitators on how to teach the course. If teachers are willing to meet the challenge, all could find themselves involved in a teaching model that will guide students to new heights of understanding and rejuvenate early teaching ideals.

Hence, this research was conducted, to develop an issue-based instructional model and course syllabus in STS that compliments the instructional model. It is the integration of societal and technological issues that makes science content much more meaningful.Thus, a properly orchestrated STS issue-based instructional model and course syllabus gives the course an exciting learning experience for both teachers and students.

This study was anchored on theories of constructivism, progressivism, instructional design theory, and the CMO No. 20 series of 2013 by Elliott, Kratochwill, Littlefield Cook, & Travers (2000), Dewey (1938), Smith & Ragan (2005), and the Commission on Higher Education (CHED), respectively.

Statement of the Problem

This study sought answers to the following research questions:

1. What are the prevalent teaching approaches used in teaching Science Technology and Society (STS)?
2. What are the course facilitators' challenges in teaching Science Technology and Society (STS)?
3. What instructional model and course syllabus can be designed to address these challenges?
4. What are the students' and course facilitators' evaluations of the Issue-Based Science Technology and Society (STS) instructional model in terms of; a) relevance, b) appropriateness, and c) versatility?

Research Design

The type II developmental research design was utilized in this study (Richey, & Klein, 2013). Developmental research is a systematic study of designing, developing, and evaluating instructional programs, processes, and products that must meet the criteria of internal consistency and effectiveness. It is particularly important in the field of instructional technology because it focuses more on the impact of the product on the learner or the organization and contributed much to the growth of the field as a whole, often serving as a basis for model construction and theorizing.

Respondents

The 38-course facilitators purposively chosen from the different State Universities and Colleges in Panay Islandserved as a source of data for analyzing the teaching approaches and challenges of the STS course facilitators. From the 38 course facilitators, 6 were identified for the online interview to gather more data to further validate the information in the analysis phase. Three (3) STS course facilitators implemented the Issue-based instructional model and STS course syllabus together with their 67 STS students. They also served as evaluators of the model and course syllabus in terms of its relevance, appropriateness, and versatility.

Data Gathering Instruments

Five (5) research instruments were designed by the researcher to collect relevant data to answer the specific questions advanced in this study. They were: (a) Teaching Approaches Questionnaire (TAQ), (b)Teaching Challenges Questionnaire (TCQ) with Coping Mechanism Open-ended Question (CMOQ) (c) Interview Guide Questions (IGQ) (d) Validator's Guide (VG), and (e) Evaluation Guide (EG). All instruments underwent content and face validation by experts in the academe. All instruments underwent content-and-face validation by experts in the academe. To do this, the validators looked into the extent to which the researcher made tests thoroughly and appropriately assessed the teaching approaches and challenges of the course facilitators and if it would measure what it intended to measure. Also, the evaluators looked into how the test appeared, such that all needed questions were asked and appropriate language was used.

Data Collection Procedure

This study employed Input-Process-Output with a modified ADDIE Model which involves the following phases: analysis, design, develop, validate, refine, implement, and evaluate the issue-based instructional model and the course syllabus. This study employed Input-Process-Output with a modified ADDIE Model which involves the following phases: analysis, design, develop, validate, refine, implement, and evaluate the issue-based instructional model. ADDIE model is a general and simplified instructional system design (ISD) (Venkatesh & Wong 2012).

Results and Findings

Audio-visual Aids. This result highlights the over-reliance of most STS course facilitators on textbooks or other printed materials as references. This can be taken to mean that not all classrooms have the luxury of state-of-the-art technology available for use. Many of the schools, if not all of them, still rely on books as the primary reference used in class. In addition, this may be attributed to the technical skills of most STS course facilitators, which hinder them from using state-of-the-art facilities and gadgets. Another most prevalent audio-visual aid used in the STS class was projected visuals. This would mean that the course facilitators would find it easy o teach the topics if a visual presentation in PowerPoint is being used. This result supports the study conducted by Gilakgani (2012) that projected visuals popular in classrooms can help enhance teaching and learning. This further supports the result of the study conducted by Jarosievitz (2015), that audio-visual materials have been found to encourage reading and watching of visual learning materials among students. Other audio-visuals commonly used in the STS classroom are films and videos. Since STS talks more about technology and its impact on society, film and videos are very much helpful on the part of the course facilitators. These allow students to see the development and impact of technology from other places. This is also an excellent substitute for field trips which are now discouraged, due to the CHED-imposed moratorium on field trips among schools in the country. Videos can bring a subject to students in a completely new way and help them comprehend the material they are reading or working on. Other prevalent audio-visual aids used in the STS classroom were non-projected materials like chalkboards, multipurpose boards, display boards, graphic materials, photographs, and illustrations. This goes to show that the course facilitators would still make use of the traditional ways of teaching. Their lack of skills in manipulating the new gadgets and the absence of state-of-the-art learning materials could be factors behind their preference for non-projected visuals in teaching STS. In addition, the use of non-projected media does not need equipment like LCD, or overhead and opaque projectors, which are not within the grasp of some course facilitators who are not "tech-savvy" in most cases. in addition to what was mentioned, non-

projected materials are very convenient to use especially if the course facilitator cannot prepare the teaching aids in advance, not to mention the applicability of the non-projected visuals to different levels of instruction and discipline.

Teaching Activities Conducted. Theresult shows that the course facilitators usually resort to presenting facts and citing their significance and connections to their daily lives. This is primarily done for the reason that the course facilitators understood clearly that once the students can connect to their lesson, they will participate actively in the discussion. The course facilitators find it difficult to teach their students to be critical thinkers, especially in dealing with different issues of STS. Most of the time, students are easily swayed by fake news because they fail to look into the veracity of the information received. Also, it showed that most of the time, the course facilitators would do the lecturedemonstration in teaching the STS course. In doing this, they can share and connect facts to real-life scenarios. These results support those of the study conducted by Macdonal, Manduca, Mogk, & Tewksbury, (2015). Most of the time, course facilitators utilized the lecture method in their classrooms where students merely received information. However, Bidabadi, Isfahani, Rouhollahi, & Khalili (2016) mentioned that the best teaching approaches are mixed methods, accompanied by educational planning and previous readiness.

Instructional Strategies/Techniques. These results revealed that the course facilitators would always employ small-group discussions. This is a teaching technique where students discuss issues to achieve understanding and consensus after much consideration of the viewpoint of others. It promotes the sharing of information and open-mindedness, and all members will gain insight concerning the thoughts of others before reaching a consensus on a topic (Brewer, 1997). Meaningful group discussion can lead to cognitive benefits by engaging students in deep reflection on their ideas. Another prevalent teaching technique employed in STS class was reflective discussion/reflective writing. More than the learning of concepts, STS is centered more on the development of values and the right attitude of students in dealing with the different issues confronting the present time. A reflection is a form of mental processing that people use to fulfill the purpose of achieving some anticipated outcome (Habib, 2017).

Other teaching techniques used were dramatization, skits, and play. Another prevalent teaching technique employed by course facilitators was a forum where students' ideas and views are exchanged. In this technique, students are allowed to discuss a particular issue among themselves.

Table 1
STS Course Facilitators' Teaching Approaches

Rank		SD	M	Descriptor
A. Most Prevalent Audio-Visual Aids Used				
1	Books and duplicated materials like textbooks, resource materials, and workbooks.	0.63	3.24	Prevalent
2	Projected visuals like overhead projector, film trips, slides, and opaque projections	0.86	3.11	Prevalent
3	Films and videos	0.75	3.08	Prevalent
4	Non-projected materials likeChalkboards, multipurpose boards, display boards, graphic	0.82	2.84	Prevalent

	materials, and photographs and illustrations.			
B. **Most Prevalent Teaching Activities Conducted**				
1	Present facts by citing their significance and connecting them with everyday life	0.51	3.47	Very Prevalent
2	Lecture demonstration	0.73	3.29	Very Prevalent
3	Group and Class projects	0.75	3.24	Prevalent
4	Illustrate laws and principles with concrete examples	0.56	3.11	Prevalent
C. Most Prevalent Instructional Strategies/Techniques				
1	Small-Group Individual	0.72	3.02	Prevalent
2	Individual or group reporting	0.82	3.03	Prevalent
3	Reflective discussion/ reflective writing	0.63	2.92	Prevalent
4	Dramatization, skits, and play	0.81	2.87	Prevalent

Scale: 3.51 – 4.00, very prevalent; 2.51 – 3.50 prevalent; 1.51 – 2.50, somewhat prevalent; 1.00 – 1.50 not at all

Challenges Encountered by STS Course Facilitators

Readiness to Teach. The results revealed that the course facilitators have difficulty developing students' critical thinking skills. In effect, the students of the present generation lack the skills in analyzing facts and making judgments, especially on different social issues confronting the world. They are easily swayed by the fake news they read on social media. Most of the time they fail to verify the veracity orthe truthfulness of the issue. Another teaching challenge experienced by the course facilitators was "inadequate preparation time". This could mean that the course facilitators do not have enough time to prepare for their lessons. This is due to the many work assignments given to them aside from their teaching loads. This result of the study supports the study of Boakye & Ampiah (2017) that one of the major challenges in teaching science-related courses is the inadequate time to prepare the learning materials. This result also supports the study conducted by Alsharari (2016).

Another teaching challenge encountered by the STS course facilitators was the "lack of skills in motivating students who are not scientifically oriented to actively participate in the class". As a general course, STS is offered across different programs in college. Many of these programs are not science-oriented and some students are not really into science courses. With this, it is very challenging to educate them to value and love the course. Another teaching challenge encountered by the course facilitators was "inadequate academic preparation". This would mean that not all course facilitators have good preparation or background in the STS course. Another teaching challenge encountered by the course facilitators was the "difficulty in preparing evaluation tools and assessment methods" in STS. In any course, choosing the right assessment tools that are appropriate, fair, and easily understood by both course facilitators and students is very important.

Learning Resources. Based on the result, a lack of learning resources is considered fairly challenging by STS course facilitators in most SUCs in Panay. Learning resources are important because they can significantly increase the learning of the students, and they can acquire higher motivation that leads to wonderful learning outcomes. But the availability of these learning resources is limited. This result agrees with the study conducted by Boakye & Amphiah (2017), that the most challenging part of teaching is the lack of learning resources. The same challenge

was found by Jessani (2015) and Ole (2020) in their studies, that resources and school facilities have a major impact on the teaching-learning process, especially in science classes.

Science is fast-moving, textbooks can't provide cutting-edge information, and access to research journals is expensive were the other challenges identified. Scientific concepts are very dynamic. Every day new knowledge may be discovered and new technology may rise. Thus, the purchase of books must be done regularly every year to make sure the information is relevant and timely. Another teaching challenge identified by the course facilitators was, that the topics in the course syllabus are too many. There are topics in the syllabus which are not familiar to students and course facilitators and which need technical expertise to discuss their concepts. The topics included in the course syllabi were overwhelming. There were unfamiliar topics included in the syllabus. Another teaching challenge encountered by the course facilitators was coming up with activities that will spark imagination and fit the STS course. This means that students' interest is very important in science classes like STS. The course facilitators must carefully choose the right activities that capture students' interest and spark their imaginations at the same time. This finding supports the result of the study conducted by Alsharari (2016), that students lack interest in science because the activities employed do not appeal to them.

Students' Readiness and Attitude Towards the Course. The results show that the teaching challenge encountered by the course facilitators was, that the students are very dependent on google. This would mean that students are considered digital natives. They have lived through the computer and internet revolutions, while they have only known a world with "high-tech" opportunities. For them, everything is available on the internet. They believe that all answers to questions could be found in the goggle. Many of these students just copy and paste the information found on the internet. Also, one of the challenges encountered was the difficulty in creating connections to students' interests and goals. If students cannot find meaning and connections to the topics, they usually fail to appreciate their essence, and they may just learn passively.

Administrative Support. The moratorium on field trips and educational toursseemed to be a challenge to course facilitators. STS would deal more with the effect of science and technology on society. Thus, it is believed that students can learn better from this interaction when they have the chance to experience what they have learned in the classroom in a real-life scenario. Students' actual experiences could create a better understanding of concepts.

Another challenge was the paucity of resources and/or funding. The course facilitators expect that the administration must provide them with enough functional learning materials. But as always the case, most higher institutions lack state-of-the-art facilities to meet the demands of the changing times. Science courses are demanding as far as facilities are concerned. They require higher budget allocation from the administration.

Another teaching challenge was the lack of collaboration with institutions, organizations, and individuals to acquire relevant STS information. Many of the course facilitators were not sent to seminars and conferences to be able to meet other course facilitators for possible collaboration and to learn best practices from other institutions. Lack of budget is another factor that limits the institution from sending course facilitators to seminars and conferences. Another teaching challenge was the lack of institutional commitment to science.

Table 2
STS Course Facilitators' Teaching Challenges

Rank		SD	M	Descriptor
A. Course Facilitators' Readiness				
1	Difficulty in developing students'	.59	2.16	Fairly Challenging

	critical thinking skills.			
2	Inadequate preparation time.	.63	2.08	Fairly Challenging
3	Lack of skill in motivating students who are not scientifically oriented.	.65	1.95	Fairly Challenging
4	Inadequate academic preparation.	.59	1.92	Fairly Challenging
B. Learning Resources				
1	The availability of instructional media in the school is insufficient.	.71	2.34	Fairly Challenging
2	Science is fast-moving, and the textbook can't provide cutting-edge information, and access to research journals is expensive.	.74	2.32	Fairly Challenging
3	The topics included in the syllabus are too many	.64	2.26	Fairly Challenging
4	Coming up with activities that will spark imagination and fit the course STS.	.60	2.26	Fairly Challenging
5	How to keep students on the task in the science classroom is challenging	.58	2.19	Fairly Challenging
C. Students' Readiness and Attitude Towards the Course				
1	Today's students can be thought of as a "Google Generation.	.69	2.97	Challenging
2	Students have varied abilities to deal with the construction of ideas.	.70	2.81	Challenging
3	Difficulty among students to determine or identity facts from opinions, trustworthy from untrustworthy STS websites.	.79	2.37	Fairly Challenging
4	Lack of the development of the requisite knowledge, skills, and disposition necessary for STS.	.57	2.11	Fairly Challenging
5	Difficulty in creating connections to students' interests and goals.	.47	2.00	Fairly Challenging
D. Administrative Support				
1	Moratorium on field trips and educational trips.	.98	2.29	Fairly Challenging
2	A paucity of	.77	2.0	Fairly

	resources and/or funding.		5	Challenging
3	Lack of collaboration with institutions, organizations, and individuals to acquire relevant STS information.	.65	1.89	Fairly Challenging
4	Lack of institutional commitment to science.	.62	1.86	Fairy Challenging
5	STS Classes are not assigned to a "primetime" schedule and conducive learning environment (Classrooms).	.87	1.82	Fairy Challenging

Scale 3.51 – 4.00, very challenging; 2.51 – 3.50, challenging; 1.51 – 2.50 fairly challenging; 1.00 – 1.50 not challenging at all

The Issue-Based Instructional Model in Science, Technology and Society (STS)

The output of the study, theIssue-Based Instructional Model in STS, and the accompanying course Syllabus were evaluated by the course facilitators and students in terms of their relevance, appropriateness, and versatility. The evaluators found it to be “very relevant, “very appropriate”; and “very versatile”.

The Issue-based Instructional Model

The developed issue-based instructional model is a student-centered approach to learning that involves students’ working, understanding, and reflecting on real-world issues brought about by science and technology to society. This teaching approach exposes students to complex real-world problems as a vehicle to promote student learning of concepts and principles in Science Technology and Society (STS).

Students do not only have good ideas, but they may have new, unique, and better ideas if appropriately guided. These students are ready to tackle the problems/issues with active engagement. Through issue-based instruction, students strengthen their research skills, communication skills, critical and rational thinking skills, and problem-solving skills, create values essential for life-long learning, and develop and sharpen their social responsibility and accountability.

In this model, time is spent in analyzing STS real-world issues holistically beginning with the understanding of the historical

context of the problem, followed by the discussion of the scientific concepts, then identifying the technology involved, analyzing its impact on society, and deliberating on the social and ethical implications of this issue to seek out deeper learning of the topic. This unique compartmentalization of the topics will give students ample time to explore the issue. The students focus more on issues related to problems they encounter in daily life. And, they need to understand the history and concept of science to interpret the impact of science and technology on society.

The discussion of the different parts of the topic will give the students a complete and comprehensive understanding of the issue, which may help them become compassionate learners who are mindful of what is happening around them. Emotional and critical thinking skills are mutually essential in producing such compassionate citizens. If minds are trained to cultivate authentic compassion, students will be more effective in responding to others' needs and helping themselves solve their suffering. Genuine compassion can be developed by accustoming the minds to the common humanity and equality of all people, which compel them to take actions for the good of all (Lama Dalai, 2011).

This instructional model will also challenge the students to examine both sides of the issue. Also, it will allow them to reflect on the different parts of the lesson called the "reflection highway" to prepare them to become more rational in all their arguments and, most importantly, train them to make the right decisions in life. They are students who are sensible and can decide based on intelligent thinking rather than emotion. After the lesson, the students are expected to think deliberately and realistically. They may think ahead and weigh the outcomes of performing specific actions or verbalization to better navigate a situation. This teaching approach is quite different from the direct teaching method, where the teacher purely presents facts and concepts without touching the learners' inner spirit.

Using this teaching model, the students will have a chance to enhance their judgment of specific issues confronting society brought about by science and technology. According to the CMO no. 20 series of 2013, students are expected to have a capacity to reflect on shared concerns and think of innovative, creative solutions guided by ethical standards and must have the ability to reflect on moral norms as they affect individuals and society. The students focus more on issues related to problems they encounter in daily life. Thus, they need to understand the history and concept of science to interpret science and technology's impact on society.

This teaching model is aligned with the goal of general education of the CHED, which is to produce thoughtful graduates imbued with (1) values reflective of humanist orientation, (2) analytical and problem-solving skills, ((3) the ability to consider the ethical and social consequences of a certain course of action; and (4) the ability to learn continually throughout one's life that will enable them to live meaningfully in a complex, rapidly changing, and the globalized world while engaging their community and the nation's development issues and concerns (CMO No.20 series of 2013).

The Science Technology and Society (STS) course syllabus compliments the issue-based instructional model developed by the researcher. This contains four (4) major units with major issues namely; biomedical issues, economic issues, communication and transportation issues, and environmental issues. A list of specific issues was provided under each unit.

Conclusions

The Science Technology and Society (STS) course facilitators still cater to the learning styles of the students who are mostly visual learners. Thus, there is a prevalence of the use of visual materials. Moreover, these materials are commonly available and within the reach of the STS facilitators. So, the STS facilitators need to cater to the students'

learning styles for an effective learning process.

Concretizing the science concepts and relating them to a real-life situation is an integral part of Science Technology and Society (STS) instruction. Thus, these students become more scientifically, technologically, and socially aware, sensitive, and empathetic citizens.

When STS is taught using the active learning strategies, the students are directly involved in the learning and the instructor assumes the role of being a facilitator of learning. Through this, students become actively involved in their learning as they learn from interacting with their peers. In many instances, teachers who are made to teach STS are not academically prepared to handle the course. As such, they tend to grapple with preparation, thus needing more time to cope with it.

The proliferation of information in social media, "fake" or otherwise, can be easily accessed and students become receivers of wrong information if they do not verify the veracity of the information, they read or downloaded. Thus, they don't develop their critical thinking skills.

Science Technology and Society is offered just recently and many school administrators are not yet fully aware of the significance of the course. Thus, the administrators could allowa bigger budget for the acquisition of the teaching-learning materials.

The development of the issue-based instructional model and the course syllabus in Science Technology and Society (STS) promote convenience in the teaching and learning of the course. It could be concluded that with the five (5) phases of the model, namely historical context, science concepts, technology involved, impact on society, and social and ethical implication of the issue, the students have a deeper understanding of the topic. The presence of the reflection highways in the instructional models give time to the students to express their thoughts and opinion regarding the issue.

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