ICT INTEGRATION IN SCIENCE,TECHNOLOGY,AND SOCIETY (STS) COURSE

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ABSTRACT

This research study explored information and communication technology (ICT) integration of STS teachers in three higher education institutions. The study utilized a descriptive research design. It uses purposive sampling (N=10) in administering the survey questionnaire to Science, Technology and Society (STS) teachers who voluntarily participated from three state universities in region 8. Results revealed that STS teachers consider ICT integration as highly important in their STS classes and a moderate support of the administration regarding ICT implementation in the universities. Further, STS teachers utilize ICT resources, particularly word processing and PowerPoint software in-class instruction. The results of this study indicate that teachers in higher institutions consider ICT integration as highly important in delivering instruction and providing quality education. To attain successful and sustainable implementation, support from the administration is likewise necessary. It is therefore, recommended to have a comprehensive and integrated ICT framework of the university.

KEYWORDS: *communication technology, e-learning, implementation, ICT-based instruction, science education*

INTRODUCTION

Various literature states the need for educators to integrate information and communication technology into instruction. It is believed to increase students' performance as well as providing pedagogical approaches to teachers. Arshad and Ahmed (2015) chronicled information and communication technology (ICT) as the foundation of the information society, which catalyzes the educational reform, which changes a learner to be a productive worker of knowledge. In support, Salihi (2015) posits that students' interest in science education is analyzed in the context of information and communication technology. Vis-à-vis information and communication technology, Šorgo et al. (2010) point out significant ICT role in schools such as the fulfillment of societal expectation for ICT skills and raising the quality education with the support of ICT. The use of information and communication technology heightens the quality of education by helping teachers perform their duties and the learners to learn effectively (Goktas et al., 2009). In context, the integration of information and communication technology can accelerate, innovate, enrich to encourage, motivate, and deepen students' skills and strengthen teaching (Arshad & Ahmed, 2015). ICT is influential in bringing changes in ways of teaching (Bingimlas, 2009). It eventually provides opportunities for students to learn to operate in an information age (Bingimlas, 2009). Accordingly, Ahmad (2014) added that information and communication technology usage significantly enhances the quality of teaching and students' learning experiences, especially in science subjects.

Particularly, empirical research further acknowledged that integrating information and communication technology (ICT) has an impact on learning and teaching Science (Adeyemo, 2010). Aside from that, the increase of ICT use creates a more student-centered learning environment where students engage more (Laronde et al., 2017).

Consequently, the use of information and communication technology has a significant impact on students learning as well as superiority in science instruction (Adeyemo, 2010; Ahmad, 2014). Ghavifekr et al. (2016) believed that ICT in education has the potential to transfer teaching. Most education experts agreed that information and communication technology hold great promise to improve teaching and learning (Adeyemo, 2010). Subsequently, ICT plays a more significant role in a curriculum emphasizing scientific reasoning and analytical skills (Adeyemo, 2010). Furthermore, with the emerging trend in educational praxis, the most widespread change in the science curriculum is integrating information and communication technology (ICT) in teaching. However, the need for effective ICT integration requires well-trained individuals to use 21st-century technologies (Manzano, 2023). Nonetheless, schools use primary ICT resources to integrate into the teaching-learning process (Alemu, 2015). Typically, teachers utilized ICT equipment for specific tasks such as the use of the world wide web in finding information, the use of PowerPoint presentations and professional graphics software as tools and aids to present complex science concepts, and the use of email to communicate with students about science ideas (Ahmad, 2014; Rabah, 2015;

Raman & Mohamed, 2013). Aside from that, ICT can also provide real-world examples and simulation visual and audio illustrations from a wide range of sources as chronicled by Alkahtani (2017). For this reason, teachers have realized that ICT can potentially intensify the quality of teaching and learning (Kubiatko, 2010). From the above literature, the integration of information and communication technology has a profound benefit and advantages in many facets of the teaching and learning process. Studies were also evident focusing on the strengths of integrating information and communication technology in the context of science education.

Grounding in various literature, this study aimed to assess the degree of information and communication technology integration in in teaching Science, Technology, and Society (STS) Course.

Explicitly, this research project aimed to 1) identify the degree of ICT integration in science classes considering the following factors, such as the importance of ICT integration and administrative support, and 2) identify ICT resources utilized by teachers in instruction.

Statement of the Problem
The study aimed to assess the degree of information and communication technology integration in in teaching Science, Technology, and Society (STS) Course. Specifically, it sought to answer the following questions:

1. What is the degree of ICT integration in STS class considering the following variables:
   1.1. importance of ICT integration;
   1.2. administrative support; and
   1.3. ICT resources utilized by teachers.
2. What recommendations can be offered based from the result of the study.

METHODOLOGY
Research Design
This study specifically employed a quantitative research design in assessing the degree of information and communication technology integration of STS teachers in the use of ICT in instruction. Mainly, this study used the descriptive design to probe the research problem. The use of quantitative design enables the researcher to gather quantitative responses from the respondents regarding information and communication technology integration in their instruction.

Participants and Sampling Procedure
This study was conducted at the three (3) universities in region 8. Through purposive sampling, the study involved faculty who are teaching Science, Technology and Society (STS) course in the said locale of the study. Ten (10) STS teachers voluntarily participated in the conduct of the survey.

Instrumentation
A descriptive survey questionnaire about the degree of ICT integration in science classes according to the importance of ICT use, administrative support, ICT resources utilized to enhance science instruction was devised based from literature and studies previously conducted by Bingimlas (2009), Ghavifekr et al. (2016), Goktas et al. (2006, 2009), Meenakshi (2013), Özdemir (2017), Villalba et al. (2017) and Zare-ee (2011). The survey questionnaire is consisting of a 10-point Likert scale of interpretation. To ensure the validity of the items in the questionnaires, a group of experts in science education evaluated its relevance and validity. The modified research instrument has been pilot tested using a different group of respondents in the different university to ensure the reliability of the items using the Cronbach alpha coefficient, having a strong reliability.

Ethical Consideration
The administration of the survey questionnaires to the respondents was made through the use of informed consent and the willingness of the participants to voluntarily engage in the conduct of this study. "To ensure the safety and rights of the possible participants, informed consent, voluntary participation, rights of participants, anonymity, and confidentiality were considered" (Chigona et al., 2010 cited in Manzano, 2023, p. 150).

Treatment of Data
Statistical tools utilized in this study include the use of means to assess the degree of importance, administrative support and availability of ICT resources and materials utilized by teachers.

RESULTS and DISCUSSION
This presents the data gathered, presentation, analyses, and interpretation of the results of this study. This section shows the data and results of the survey on the degree of integration of information and communication technology in STS classes relative to the importance of ICT integration, administrative support, and ICT resources utilized by teachers in STS classes in selected higher education institutions.

Table 1
Mean Scores of STS Teachers Responses on the Importance of ICT Integration

Indicators	Mean	Interpretation
1. ICT resources and materials are powerful tools in delivering Science, Technology and Society instruction.	9.60	HI
2. The use of ICT software and hardware in my teaching will increase my efficacy as a science teacher at the university.	9.00	HI
3. PowerPoint presentation, graphics software's, YouTube and other digital resources are significant tools in delivering abstract and complex STS lessons (e.g., biodiversity and healthy society, genetically modified organisms, the Nano world and gene therapy).	9.50	HI
4. The use of ICT is helpful to science teachers to effectively develop instructional material vis-a-vis content and pedagogy to cater to the need of students in specific STS lessons.	9.20	HI
5. The use of ICT resources in teaching selected topics such as biodiversity and healthy society, genetically modified organisms, the Nanoworld and gene therapy helps fast and easy delivery of knowledge than the traditional method and provides students a visual presentation of abstract ideas.	9.50	HI
6. The use of ICT resources provides teachers various pedagogical techniques.	8.80	HI
7. ICT materials can be used as a supplementary curriculum material in enhancing student academic performance particularly in the field of science education.	9.00	HI
8. Through ICT integration, students' technological skills are honed while emphasizing developing their 21st-century skills.	8.90	HI
9. The use of ICT when utilized holistically can improve students learning achievement.	9.20	HI
10. ICT integration in science instruction is important in the development of learners' critical thinking and decision making.	8.50	HI
Total Mean	9.12	HI

Legend: HI = highly important

Presented in table 1 are the mean scores and interpretations of teachers' responses to the importance of ICT integration in STS classes. As shown in the table, the respondents rated the importance of ICT integration as highly important with a grand mean of 9.12. Indicators 1, 2, 3, 4, 5, 7, and 9 were found to be highly important, with obtained mean scores ranging from 9.0 to 9.6, respectively. Indicators 6, 8, and 10 on the use of ICT resources to provide various pedagogical techniques, ICT integration in honing students' technological skills, and the importance of ICT integration in the development of learners' critical thinking and decision making were also rated highly important by the respondents with an obtained mean score of 8.5 to 8.9 respectively.

The results revealed that the respondents' overall rating on this variable shows how information communication and technology are essential in delivering not only STS instruction but also science instruction as a whole. This result may imply that teachers believed that ICT is a powerful tool to be used in instruction. Consequently, it helps increase their efficiency as teachers and, more importantly, the convenience and the advantages of information and communication technology resources brought in the science classroom. The utilization of PowerPoint presentations, graphics software, and other digital resources and materials is common in the teaching-learning process. Moreover, the data may further indicate that STS teachers believed that the use of information and communication technologies is highly important in improving students learning achievement when utilized holistically. This idea is similar to that of Manzano (2023) in which technology competence boils down to how teachers would help learners hone their skills through technology.

STS teachers find information and communication technology integration as highly important since they understand how important technology in education (Manzano & Reyes, 2020). Though the respondents rated the importance of integration as "highly important" it can be assumed that there is a moderate integration that prevails with the inadequacy of ICT resources. Moderate integration in STS courses means that teachers utilize a moderate number of ICT resources but are not limited to the use of essential computer software and hardware like laptops and projectors.

Generally, the integration of information and communication technology in science and this study--STS instruction is very much necessary provided by various authors in which they admitted that integration of information and

communication technology (ICT) has a positive impact on the teaching-learning process. Therefore, this view on how vital ICT implementation in the educative process is simply one of the demands brought by advances in the educational system as teachers cater to the development of knowledge and skills of individual learners as they become the builder of their knowledge. The high perception of teachers towards the importance of ICT in instruction is an influence on the belief that it will benefit every learner to learn and understand more in the 21st-century teaching process. As such, the need for ICT integration in-class instruction is no longer in doubt, particularly in the field of education, and to be specific in science learning. Alwani and Soomro (2010) opined that ICT is becoming more evident today, especially in the education sector. Adeyemo (2010), on the other hand, stressed that information and communication technology hold great promise to improve teaching and to learn, particularly in the field of science. The role of ICT in science education cannot be over-emphasized as it promotes higher-order thinking, problem-solving, improved communication, and deep understanding (Abdullahi, 2014). Moreover, administrative support is another variable that influences ICT implementation in higher education institutions. Support through budget allocation for ICT infrastructures, professional development, and other institutional support is necessary for providing sustenance of program implementation.

Table 2 presents the mean score distribution and interpretation of respondents' responses on administrative support towards the successful implementation of technology. The study revealed that with regard to administrative support, the administration is moderately supportive towards ICT implementation in the institution with a composite mean of 6.40. Based on the responses, "The deans and heads of the college require the faculty members to integrate ICT into their science classes" and "The university has budget provisions for ICT implementation" are among the two highest indicators having both a mean score of 7.1, which is interpreted as moderately supportive. Statements 5, 6, and 8 were found to have a slightly supportive administration, obtaining a mean score ranging from 5.5 to 5.9 correspondingly.

Table 2
Mean Scores of STS Teachers Responses on Administrative Support

	Indicators	Mean	Interpretation
1.	The college deans and program heads support and encourages science teachers to attend ICT related professional development training.	6.80	MS
2.	The college is supportive in establishing ICT framework to effective ICT integration.	6.80	MS
3.	The deans and heads of the college require the faculty members to integrate ICT into their science classes.	7.10	MS
4.	The university has budget provisions for ICT infrastructures both hardware and software to support ICT implementation.	7.10	MS
5.	There is a well- established scheduling system in distributing class schedules provided by the administration to prepare ICT materials effectively.	5.90	SS
6.	There are a well-equipped computer laboratory and available ICT resources in the classroom to support e-learning activities	5.80	SS
7.	There is a defined university-wide if not a college-based ICT integration program to support ICT based learning of students' 21st-century skills, particularly in science education.	6.20	MS
8.	In support, there is a periodic observation of faculty in the use of ICT resources to ensure successful implementation.	5.50	SS
	Total Mean	6.40	MS

Legend: SS = slightly supportive; MS = moderately supportive

The composite mean score rating indicates that the administration is moderately supportive when it comes to ICT implementation. However, despite the claim of STS teachers where ICT is highly important in science classes, moderate integration of information and communication technologies in instruction is provided. Teachers considers the use of ICT as highly important due to its given advantages; however, moderate support is extended by the schools' administration, which affects the implementation process. This results in moderate integration and utilization of ICT in their instruction. Furthermore, results imply the need to establish an ICT framework and a development plan on ICT implementation as far as the findings are concerned. It can be deduced from the results that gearing toward a scientific and technologically literate learner, supervisory plans of deans and program heads may also tailor the inclusion of ICT integration in every class instruction. The degree of administrative support received by teachers likewise impacts the implementation of information and communication technology and the capability of

STS teachers to use their knowledge in terms of technology, pedagogy, and content. Accordingly, support is needed as every institution gear towards globalization, promotes sound science education in the country, and develops the 21st-century skills of the learners.

Administrative support is a provision given by the school officials and administrators to provide sustenance to achieve specific goals and objectives of the institution. As Manzano and Magalona (2023) uttered that practical training may enhance the professional competence of teachers. This support may be in the form of budget allocation, resources, and another supervisory implementation to attain effective and sustainable implementation. Ghavifekr et al. (2014) chronicled that some schools lack a clear vision and mission in using ICT integration and motivating teachers to integrate technology in their respective classes.

Table 3
Mean Score of STS Teachers Responses on ICT Resources Utilized

Indicators	Mean	Interpretation
1. I use word processing in presenting STS lessons through the use of case studies, journal critique, and visualization.	8.1	MU
2. I use PowerPoint presentation in delivering STS lessons particularly in topics, e.g., biodiversity and healthy society, genetically modified organisms, the Nano world and gene therapy.	8.6	HU
3. I use email to communicate STS related activities and ideas to my students for reading and enrichment activities.	7.4	MU
4. Social networking sites (Facebook, Twitter, etc.) used for posting articles related to STS content ideas for online supplementary reading.	6.6	MU
5. I use a course management system (Moodle, Edmodo, etc.) in delivering STS instruction.	4.8	SU
6. Laptop or Desktop, printer, projector, and smart TV are some of the media used in delivering instruction.	9.0	HU
7. YouTube (Videos and Music) are utilized to supplement the discussion of topics needing visual texture such as genetically modified organisms, the Nanoworld and gene therapy.	7.8	MU
Total Mean	7.42	MU

Legend: HU = highly utilized; MU = moderately utilized; SU = slightly utilized

ICT resources utilized by teachers is another significant indicator of the successful implementation of technology in the academe. These determined resources and materials commonly utilized by the respondents in delivering and enhancing instruction.

Table 3 presents the ICT resources commonly utilized by teachers when delivering instruction in their respective STS courses. The study revealed that these resources are moderately utilized with a total mean of 7.42. As gleaned from the responses, the highly utilized resources are laptops or desktop, printer, smart TV, and other medium used in delivering instruction got the highest mean of 9.0. However, the use of word processing in presenting STS lessons and the use of email to communicate STS-related activities are moderately utilized by teachers with an obtained mean of 8.1 and 7.4, respectively. On the other hand, teachers' highly utilized PowerPoint presentation software with an obtained mean of 8.6. Moreover, the use of course and learning management systems (e.g., Moodle, Edmodo) in delivering instruction established as slightly utilized with a mean of 4.8.

The data showed that word processing software and PowerPoint presentation software are the typical resources used in delivering instruction, while the majority of the respondents commented that they slightly utilized the use of a course management system in their respective classes. Such findings may imply that teachers are knowledgeable in the use of basic computer fundamentals and manipulation. With this, they need further professional development and adopt changes in their instruction, particularly in the use of course management systems (CMS) as part of the delivery mode of instruction. In addition, teachers may further adapt themselves to the use of these resources, possibly in delivering instruction through the e-learning platform.

The utilization of information and communication technologies in the classroom is a new trend in a twenty-first-century classroom. The use of such technology can strengthen learners' academic performance. Thus, in this study, STS teachers integrate ICT into their teaching for a specific purpose depending on the lesson or subject matter. These findings on the resources utilized by teachers corroborate the findings on the importance of ICT. Teachers consider ICT integration as highly important. Thus, utilization of ICT resources in instruction such as word processing and PowerPoint software is prevalent even there is moderate administrative support as revealed in the previous objectives.

Furthermore, this result presents the relationship of the extent of ICT utilization in STS instruction. Evidently, there is moderate use of ICT resources in delivering selected lessons in

the STS course, such as videos, PowerPoint presentations, documentary analysis. Moreover, online learning material can also be used through a learning management system (Manzano, 2023).

The findings of this study corroborate with the previous research of Ahmad (2014), in which the least ICT resources teachers could employ is PowerPoint in the explication of complex concepts; when they experienced difficulty in teaching some concepts in the subject area (Manzano, 2022). Further, Ahmad (2014), Rabah (2015) and Raman and Mohamed (2013) posited that teachers use ICT equipment for specific tasks such as the use of the world wide web in finding information, the use of PowerPoint presentations, and professional graphics software as tools and aids to present complex science concepts, and the use of email to communicate with students about science idea. Kubiatko (2010), concluded that ICT can potentially intensify the quality of teaching and learning. Moreover, in the study of Kihosa et al. (2016), it was suggested that tutors [teachers] have to be equipped with ICT skills and competence in order to be on a par with teacher trainees' prerequisites before they can go to their fields of work. Ahmad (2014) asserted that "science teachers reported not using ICT at all in their science classes" Ghavifekr et al. (2014) also found out that ICT resources or applications such as the internet, multimedia, projector system, PowerPoint presentation, and word processor are more likely utilized by teachers in the teaching and learning process.

CONCLUSION

The results of this study indicate that teachers in higher institutions consider ICT integration as highly important in delivering instruction and providing quality education. To attain successful and sustainable implementation, support from the administration is likewise necessary. Despite the advantages ICT resources can offer in the educative process, teachers have experienced several barriers that impede successful ICT integration such as lack of in-service, lack of ICT infrastructures, and poor internet access. Due to this inadequacy, teachers were able to utilize primary ICT resources in delivering instruction.

Recommendation

It is therefore, recommended to have a comprehensive and integrated ICT framework of the university. Universities are encouraged to provide provisions on ICT-based instruction by utilizing online or e-learning platforms as a modality in delivering science or selected science instruction.

Acknowledgment

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