

Technological Pedagogical and Content Knowledge (TPACK) Self-Efficacy and 21st Century Instructional Skills of Science Teachers in the New Normal

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Abstract: *This study surveyed the TPACK self-efficacy and 21st century instructional skills of Science teachers in the Divisions of Bukidnon, Malaybalay City and Valencia City, Philippines. Descriptive research design was used. TPACK self-efficacy and 21st century instructional skills were assessed using adopted questionnaires where three hundred and eighty six (386) Science teachers participated and their responses were analyzed using descriptive design. Results of the study revealed that Science teachers had a high level of knowledge of TPACK self-efficacy and were highly skilled in the 21st century instructional skills. Therefore, teachers must be given opportunities to enhance their Technological Knowledge together with their 21st century instructional skills to improve their performance in the academe.*

Keywords: science teachers, TPACK self-efficacy and 21st century instructional skills

1. Introduction

Teachers have a variety of important and necessary tasks in the classroom, ranging from simple to sophisticated, but all of them are critical and stimulating. These aspects require educators' thorough understanding and mastery of the concepts they teach, to be knowledgeable on the principles and methods of teaching, and possess competence in the use of technology instruments for education and evaluation.

These roles of teachers have been challenged in the recent days since technological innovations progressed in a logarithmic phase coupled with the pandemic leading to the need of each of the educators to be well versed with computers, ICT, cellphones and the internet. Nowadays, there is an urgent and persisting need for integrating technology in the learning process especially that the learners of this age are reliant with the presence of technology (Aquino, 2015). The integration of technology in teaching is described as Technological Pedagogical and Content Knowledge (TPACK). As technology has penetrated in almost every aspect of our life, there is a need for teachers to master the ability of incorporating technology in the curriculum for innovative and relevant teaching.

With this at hand, today's teachers are expected to positively and effectively integrate technology into their teaching, however, Chen (2008) found out that some teachers lack adequate skills and competencies in properly implementing technology in the teaching and learning process. Kane and Staiger (2012) in their study entitled *Measures of Effective Teaching* reported that teachers score lowest for complex teaching skills such as questioning, discussion techniques,

and communicating with students about content using technological tools. With this, the performance of teachers in delivering the needed education has also been affected much more since there is the sudden outbreak of COVID-19 since the end of 2019. Teachers are forced to quickly adapt to the modes of teaching with the aid of technology so that learning can still go on even if there is the suspension of face-to-face class schedules.

Recently, another factor that teachers are prompted with is their ability, capacity and confidence with their skills in the 21st century instruction. Specific teaching approaches that govern classroom engagement are known as instructional practices. Teachers employ instructional practices to bring learners ahead in their learning in a more efficient manner.

As of to date, there are yet limited studies tackling the data of Filipino Science teachers' TPACK self-efficacy and 21st century instructional practices. This study therefore would seek data and information on Science Teachers' TPACK Self-Efficacy and 21st century Instructional practices which can be used as the underpinning idea for their professional enhancement and shedding light on what aspects of the teachers' professional requirement may be strengthened.

2. Literature Survey

The TPACK framework builds on Shulman's (1986, 1987) descriptions of Pedagogical Content Knowledge (PCK) to explain how teachers' knowledge of educational technologies and PCK interact to produce effective technology-assisted instruction. Similar ideas have been

discussed by other authors, though they often used different labelling schemes. The concept of TPACK described here evolved over time and through a number of publications, with the most comprehensive descriptions of the framework appearing in Mishra and Koehler (2006) and Koehler and Mishra (2008).

Corry and Stella (2018) reported in their assessment of the literature on teacher self-efficacy in technology integration that scholars believe that mastery of the subject matter and mastery of subject matter with technology integration have different contexts and that teacher self-efficacy in technology integration should be investigated. The majority of the teacher self-efficacy measuring tools used for technology integration in education research were based on scales that had been internally validated for face-to-face teachers. The majority of instruments were created to assess pedagogical expertise or content-specific pedagogy, and just a handful contain considerable use of technology in the classroom. According to research, there is a relation between teacher self-efficacy and the use of technology in the classroom (Kopcha & Alger, 2011; Mishra & Koehler, 2006).

The problems of everyday life and work have changed dramatically in recent years as a result of fast technological advancements and globalization. Many businesses and educators have recognized that success in this environment of new difficulties necessitates a new set of abilities. New solutions that need more cooperation, flexibility, and invention in order to integrate a variety of shifting viewpoints and new technology are replacing old solutions that rely on fixed knowledge and linear thinking (UNESCO, 2020). This prompted a focus on implementing 21st-century instructional practices, which aim to build 21st-century abilities in learners in order for them to be internationally competitive. In recent years, studies have discovered the crucial role of the twenty-first century in the development of twenty-first-century abilities as well as the improvement of learners' academic performance. Due to the rising requirements of 21st-century industry, schools, as well as

their curriculum and accountability systems, must reflect the necessary skills for success. Many schools have started the reform process to meet these new abilities through the establishment of 21st century standards for educators and pupils. Some educators have been successful in eliciting change in their classroom instruction, while others have been unsuccessful. This is evident in Vail's (2010) study, which looks at the characteristics of educators who are presently using the Framework for 21st Century Skills and tries to understand the personal and professional constraints that prevent them from doing so. The study's findings show that many, if not all, participants support the reform movement, albeit only a small percentage are putting these principles into effect in their classrooms. Lack of knowledge and fundamental skills, a lack of money and time, pressure from high-stakes testing, and a lack of parent, student, and teacher buy-in and support were all rated as obstacles.

3. Methods / Approach

Over-all, a total of three hundred and eighty-six (386) teachers participated in the study. The participants are chosen through total sampling procedure. This includes all secondary Science teachers who are graduates of either Bachelor of Science in Secondary Education specializing in Biology, Chemistry, General Science, Physical Science and Biological Science or those teachers who are non-education graduates but have taken professional education courses whose baccalaureate degrees are science related.

This study made use of descriptive design to determine the level of teachers' TPACK self-efficacy and 21st century instructional skills. The research instrument is composed of two (2) parts. Part I dealt with the teachers' TPACK Self-efficacy adopted from Hosseini & Kamal (2012). Part II is the 21st Century Instructional Practices of Teachers that was adopted from Berja (2016).

The following rating scale was used to better understand the data:

Rating	Scale	Descriptive Rating	Qualitative Interpretation	Rating	Scale	Descriptive Rating	Qualitative Interpretation
5	4.51 – 5.00	Strongly agree	Very High level of TPACK self-efficacy	5	4.51 – 5.00	Very Frequently	Very Highly Skilled
4	3.51 – 4.50	Agree	High level of TPACK self-efficacy	4	3.51 – 4.50	Frequently	Highly Skilled
3	2.51 – 3.50	Undecided	Moderate level of TPACK self-efficacy	3	2.51 – 3.50	Occasionally	Moderately Skilled
2	1.51 – 2.50	Disagree	Low level of TPACK self-efficacy	2	1.51 – 2.50	Rarely	Least Skilled
1	1.00 – 1.51	Strongly disagree	Very Low level of TPACK self-efficacy	1	1.00 – 1.51	Never	Not Skilled At All

The researcher asked, through letters, the permission from the three (3) schools' division superintendents and from the school principals to conduct the study in all of the secondary schools of the three divisions. A Letter of permission containing the caveat that the data to be gathered will be held in strict confidentiality was given primarily to all of the participants. The participants were given an option either to indicate their names or not; anyway, there was no names that was mentioned in the study.

The quantitative data gathered were statistically analyzed using the descriptive statistics such as mean and was used to

tabulate the data for presentation and interpretation of the data in terms of teachers' TPACK self-efficacy and 21st century instructional skills.

4. Results and Discussions

Technological Pedagogical and Content Knowledge (TPACK) Self-Efficacy of Secondary Science Teachers

Table 1 displays the respective knowledge domains of the TPACK Self-efficacy. A grand mean of 4.23 was obtained from the study which has a qualitative interpretation of

“High level of Self-Efficacy” in the overall assessment of TPACK Self-efficacy among the JHS and SHS teachers of the Divisions of Bukidnon, Malaybalay City and Valencia City. Likewise “High level” was also obtained among all of the seven (7) knowledge domains: TCK has the highest mean score of 4.30; followed by CK (4.27); PK (4.25); TPK (4.23); PCK (4.22); TPACK (4.21), and TK has the lowest

mean score of 4.15. The data help us understand that at the present challenges of the overwhelming pandemic, teachers showed higher level of self-efficacy on TCK suggesting that teachers are more into relating themselves with the necessary technologies coupled with their mastery of the content in their respective fields of expertise.

Table 1: Science teachers’ level of TPACK self-efficacy

TPACK Self-Efficacy Indicators	Mean	Descriptive Rating	Qualitative Interpretation
Technological Content Knowledge	4.30	Agree	High level of Self-Efficacy
Content Knowledge	4.27	Agree	High level of Self-Efficacy
Pedagogical Knowledge	4.25	Agree	High level of Self-Efficacy
Technological Pedagogical Knowledge	4.23	Agree	High level of Self-Efficacy
Pedagogical Content Knowledge	4.22	Agree	High level of Self-Efficacy
Technological Pedagogical and Content Knowledge	4.21	Agree	High level of Self-Efficacy
Technological Knowledge	4.15	Agree	High level of Self-Efficacy
OVERALL MEAN	4.23	Agree	High level of Self-Efficacy

In the light of the study, it has been found that teachers having high level of self-efficacy in pedagogy are far more confident in the technological integration (Hosseini & Kamal, 2012) in the refinement of their knowledge in the content and pedagogy. Teachers' technological content knowledge is at the heart of effective teaching as far as the study is concerned. Educators must overcome certain traditional professional learning practices if increase in the quality of teaching and learning desired. Additionally, educators value and expand their perspectives of being specialists who use technology to enhance subject matter teaching skills which is greatly supported by the foundations of TPACK by Mishra and Koehler (2006). They are also committed to high-quality professional development aimed at furthering their knowledge. Similar to the result of this study, Ertmer and Ottenbeit-Leftwich (2010) assert that there is a strong cohesiveness between that of technology blended with Content Knowledge domain. In Semiz and Ince (2012) study, it was also discovered that maintaining a learning environment that is integrated with technology makes instruction more effective and permanent. According to Celik et al. (2014), however, the process of integrating technology into education creates severe pedagogical issues for instructors and the learning environment. The majority of these issues arise from the lack of adequate and suitable pedagogical approaches to teaching using technology (Bass, 2015).

educators, it is claimed that ‘21st century instructional skills’ such as creativity, communication, critical thinking, and cooperation have been the centre of attention and one of the most wanted skills and abilities (Simsek, 2020).

Table 2 Science teachers’ level of 21st Century Instructional Skills

21 st Century Instructional Skills Indicators	Mean	Descriptive Rating	Qualitative Interpretation
Innovative and ICT Skills	4.12	Frequently	Highly Skilled
Communicative and Collaborative Skills	4.12	Frequently	Highly Skilled
Critical and Creative Skills	4.11	Frequently	Highly Skilled
OVERALL MEAN	4.12	Frequently	Highly Skilled

21ST Century Instructional Skills of Science Teachers

Rapid changes in the world are redefining the broad skill sets that teachers need to be adequately prepared to participate in and contribute to today's societal demands, including technological advancement, scientific innovation, increased globalization, shifting workforce demands, and economic competitiveness pressures. The necessity of 21st-century instructional skills in science education is now more important than ever before in order to give learners with the necessary competency in education that they can effectively use in facing the challenges of the real-world.

Teachers have a far greater impact on students' lives than most people realize. They are instruments capable of igniting strong ideas in learners and in realizing their full potential. Being a 21st-century educator entails being able to teach and reach out to all types of students. That is, delivering the necessary skills that the students need to develop among themselves. In the premise of the study, teachers are significantly practicing the 21st century instructional skills in every subjects that they handled. It follows then that they have already developed such skills and that they are using them to improve the quality of their instruction together with the desire to improve students' progress. Durak (2019) have come up with similar result in their study asserting that teachers of the modern day do practiced these skills in the classrooms. Unfortunately, P21 (2020) stress out that teachers are having difficulty in practicing communication and collaboration instructional skills in the time of pandemic due to the fact that group work tasks are minimally given to the students.

In table 2, the overall result of the 21st century instructional skills is presented with a total mean score of 4.12 which is verbally interpreted as ‘Highly Skilled’. Since they are the primary criteria of employment credentials among

Indeed, the importance of having developed abilities, 21st century instructional skills, have been of prime significance to the participants of the study. It can be resolved that they have realized the goals of the present day educational system in the premise of developing these skills to the students by sharing what they have within their selves. Boholano (2017) also shared the same claims which emphasize the great benefit of students’ development from the efficiency that their teachers had in terms of the 21st century skills such as that of critical thinking and validation of scenarios that would be useful in the real world situation among others.

5. Conclusions

Based on the above findings, the conclusions were drawn as follows:

The TPACK self-efficacy of the Science teachers of the divisions of Bukidnon, Malaybalay City and Valencia City, Phils. was of "High level". They have strong agreement that all of the knowledge domains in the TPACK self-efficacy are necessary in their teaching.

The teachers rated themselves as highly skilled on the 21st century instructional skills. The skills include the critical and creative thinking skills, communicative and collaborative skills and innovative and ICT skills.

The overall findings showed that teachers were aware of their TPACK Self-efficacy and 21st century instructional skills. Science teachers may use this approach correctly, which might have a major impact on their multi-faceted function as knowledge inculcators, resulting in the capacity to fulfil the educational institution's goal and vision.

6. Future Scope

Researchers are encouraged to make use of TPACK Self-Efficacy instrument that is based on the needed competencies of teachers in the post-pandemic setting. Likewise, the research could be very much improved if researchers will be able to use 21st century instructional skills questionnaire that is based on the six (6) 21st century skills. Further looking at the correlation of the two variables would be an exquisite improvement to the study.

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