TEACHERS' TECHNOSTRESS AND THEIR 21ST CENTURY TECHNOLOGICAL PEDAGOGICAL AND CONTENT KNOWLEDGE (TPACK-21) IN THE POST-PANDEMIC EDUCATIONAL ENVIRONMENT

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Abstract: This study generally investigated the technostress and demographic variables among high school teachers in the southern districts of the Department of Education- Division of Bukidnon and the whole of the Division of Valencia City, Bukidnon, Mindanao, Philippines. A total of 169 teachers were the participants of the study. The Technostress survey questionnaire adapted from Chen (2018) was utilized for the purpose of this investigation. Further, the TPACK-21 survey questionnaire of Valtonen et al. (2017) was also utilized.

The statistical tools used in treating the data for analysis were the descriptive statistics (frequency, mean and percentile), correlation and regression.

The results of the study revealed an overall mean of teachers' technostress on techno-overload is 3.07; on techno-complexity 2.61; on techno-insecurity 2.33; and techno-uncertainty 3.51. The average mean of the teachers' technostress is 2.89 which corresponds to "moderately affected by stress".

A "High level of knowledge" in the overall TPACK-21 efficacy among the high school teachers of the Divisions of Bukidnon and Valencia City has been very evident in the study as shown in the grand mean of 3.97. Likewise, "High level of knowledge" was also obtained among all of the seven (7) knowledge domains: PCK has the highest mean score of 4.20; followed by CK (4.18); TCK (4.15); PK (3.99); TPK (3.92); TPACK (3.69); and TK has the lowest mean score of 3.63.

The data exposed high significant relationship with 21st Century Technological Pedagogical and Content Knowledge (TPACK-21) $r = -0.58$ ($p<0.038$). Its measured variables like Technological Knowledge (TK-21) $r = -0.10$ ($p<0.043$); Pedagogical Knowledge (PK – 21) $r = 0.82$ ($p<0.025$); and Technological Pedagogical Knowledge $r = -0.78$ ($p<0.047$). The study indicated that as the TPACK-21 variables increase, the level of technostress decreases.

Pedagogical Content Knowledge, Technological Content Knowledge, and the Technological Pedagogical and Content Knowledge are the three (3) predictor variables that were derived from the data that was made available as an outcome of the inquiry. Given that the overall influence of the three variables on the teachers' technostress was 69% ($R^2 = 0.069$), this study provides a window for the DepEd Divisions of Bukidnon and Valencia City administrators to revisit and examine the implementation and training of teachers to boost their teaching efficacy based on the status on technostress as related to their 21st Century Technological Pedagogical and Content Knowledge.

Keywords: teachers, TPACK-21, technostress and post pandemic

1. INTRODUCTION

The development and remodeling of the teaching profession have been impacted by changes in the education-teaching process, as they have in all professional fields, thanks to information and communication technologies (ICT), which have become one of life's most significant aspects and are constantly changing and improving (Graham et al., 2019). Teachers must continue learning about and improving their use of ICTs because they develop and change so quickly (Hew & Brush, 2017). This will allow them to more effectively incorporate new ICTs into their lessons. In order to help their students perform better and perform better academically, 21st-century teachers are expected to use ICTs effectively when planning lessons, creating teaching materials, instructing, and assessing and evaluating students (Kim & Hannafin, 2021).

The integration of technology and digitization in teaching is described as Technological Pedagogical and Content Knowledge (TPACK) (Anud, 2022). Digitalization in the education-training process decreases the teacher's workload and creates opportunities for collaboration. On the other hand, the need to learn information and skills regarding new technologies constantly causes teachers stress, such as higher work load and time pressure (Tarafdar et al., 2015; Anud & Caro, 2022). This expectation for the efficient use of ICTs in the education and training of today's teachers and the increasing pressures in this direction lead to instructors with insufficient knowledge and abilities to integrate the technology and may generate teacher technostress (Joo et al., 2016). Brod (1984) developed the notion of technostress, which emerged as a result of the deliberate and successful use of current technology, and classified it as a modern adaption disease coming from the inability to employ current computer technologies properly. Berger et al. (2016) also updated this definition to describe technostress as the feeling of individual stress generated by the usage of ICT technology.

The studies conducted to determine the negative effects of technostress on individuals revealed that technology caused individuals to experience negative emotions such as skepticism and inefficiency, mental fatigue, and anxiety (Agogo & Hess, 2015; Salanova et al., 2018), reducing the satisfaction of users either directly or indirectly (Tarafdar et al. 2015), and negatively affecting the users' job satisfaction and corporate loyalty (Jena, 2015). Despite the fact that numerous studies (Agogo & Hess, 2015; Salanova et al., 2013; Tarafdar et al., 2011) have identified the negative effects of technostress on individuals working in various sectors, it has been determined that there are very few studies demonstrating the method for determining teachers' technostress levels and how to deal with this stress (Fuglseth & Sreb, 2014; Jena, 2015; Joo et al., 2016). Nevertheless, research investigations that were carried out within the framework of technostress and their TPACK-21 suggest that there is a need for studies that investigate the impact of individual characteristics and educational environmental factors in a comprehensive manner.

To put this into context, the purpose of this study determined whether or not there is a correlation between the variables such as individual characteristics and TPACK-21 level to the technostress of high school research teachers.

2. MATERIALS AND METHODS

A total of three hundred and sixty-nine (169) high school teachers participated in the study. The participants were chosen through total sampling procedure.

This study made use of descriptive-correlational design to determine the level and relationship of teachers' technostress and TPACK-21. The technostress research instrument used was adapted from Chen (2018).

Following are the scale from Chen (2018) which was used in measuring the technostress of high school Research Teachers:

1- I never experience or feel this way
2- I rarely experience or feel this way
3- I occasionally experience or feel this way
4- I frequently experience or feel this way
5- I very frequently experience or feel this way

In the other hand, the following qualitative interpretation (adopted from Kader et al., 2022) which was used in interpreting the results from the technostress questionnaire:

1.00-1.50 – Not affected by stress at all (NA)

1.51-2.50 – Least affected by stress (LA)
2.51-3.50- Moderately affected by stress (MA)
3.51-4.50 – Highly affected by stress (HA)
4.51-5.00- Very highly affected by stress (VHA)

Part II dealt with the teachers' TPACK-21 which was adapted from Valtonen, Sointu, Siegl, and Kukkonen (2017). A letter of permission to utilize the instrument was sent thru the email of the author and a response has been given allowing the researchers to utilize and make modifications on the instrument. It is divided into seven (7) constructs representing the seven (7) knowledge domains of TPACK-21 with a total of 38 statements. Pilot test was also done to secure the reliability of the instrument in relation to the locale of the study considering that it is validated in the international setting. From the pilot test conducted, a cronbach alpha value of 0.970 was garnered making the instrument reliable to be utilized.

Following are the scale which is adopted from Valtonen et al., (2017) was used in measuring the level of TPACK-21 of Teachers:

1- I need a lot of additional knowledge about the topic
2- I need a little additional knowledge about the topic
3- I have some knowledge about the topic
4- I have good knowledge about the topic
5- I have strong knowledge about the topic

Likewise, the following Qualitative interpretation adopted from Anud (2022) was utilized in interpreting the results from the TPACK-21 questionnaire:

1.00-1.50 – Very low level of knowledge
1.51-2.50 - Low level of knowledge
2.51-3.50- Moderate level of knowledge
3.51-4.50 – High level of knowledge
4.51-5.00- Very high level of knowledge

3. RESULTS AND DISCUSSION

3.1 Technostress level of Teachers

Table 1 displays the summary of the variables of teachers' technostress. The overall mean of teachers' technostress on techno-overload is 3.07; on techno-complexity 2.61; on techno-insecurity 2.33; and techno-uncertainty 3.51. The average mean of the teachers' technostress is 2.89 which corresponds to "moderately affected by stress".

Table 1. Teachers' Technostress level

Technostress variables	Mean	Qualitative Interpretation
Techno-uncertainty	3.51	HA
Techno-overload	3.07	MA
Techno-complexity	2.61	MA
Techno-insecurity	2.33	LA
Overall mean	**2.89**	**MA**

As gleaned from the data, it is evident that teachers from the Divisions of Bukidnon and Valencia City, Philippines experienced/felt technological stress which is a manifestation of the key points from the principle of Technostress by Brod (1984). Though it has been observed that teachers are really doing great lengths of patience to acquire technological skills, they are still lacking provision of technological training-both in basic and in very technical tools (Bass, 2015) resulting to them experiencing or feeling stressed in the premise of not having the full knowledge of what technological tool "should" be used to effectively help them do their job efficiently. This is now the techno-

uncertainty that teachers are experiencing. It is empirical then that teachers be given due attention so that they will be able to acquire and master technological skills and at the same time lowering the stress that they may experience. Although there are a lot of debatable topics in the field of education, most people can agree on one thing: the quality of the teacher is the single most essential component in determining a student's educational experience. It doesn't matter if your classroom is equipped with the most cutting-edge technology in the world if you don't have a teacher who is able to correctly administer it and who can motivate their students to get enthused about learning (Venkatesh et al. 2003). Without that, the benefits of the technology won't be realized as being depicted on the Unified Theory of Acceptance and Use of Technology.

3.2 Teachers' 21st Century Technological Pedagogical and Content Knowledge (TPACK-21) efficacy level

Table 2 displays the summary of the respective knowledge domains of the TPACK-21 efficacy. Accordingly, a grand mean of 3.97 was obtained from the study which has a qualitative interpretation of "High level of knowledge" in the overall TPACK-21 efficacy among the JHS and SHS teachers of the Divisions of Bukidnon, and Valencia City.

Table 2. Table on the Efficacy level of Teachers; 21st Century Technological Pedagogical and Content Knowledge (TPACK-21)

21st Century Technological Pedagogical and Content Knowledge (TPACK-21) Variables	Mean	Qualitative Interpretation
Pedagogical Content Knowledge (PCK)	4.20	High Level
Content Knowledge (CK)	4.18	High Level
Technological Content Knowledge (TCK)	4.15	High Level
Pedagogical Knowledge (PK)	3.99	High Level
Technological Pedagogical Knowledge (TPK)	3.92	High Level
Technological Pedagogical and Content Knowledge (TPACK)	3.69	High Level
Technological Knowledge (TK)	3.63	High Level
Overall mean	3.97	High Level

Likewise "High level of knowledge" was also obtained among all of the seven (7) knowledge domains: PCK has the highest mean score of 4.20; followed by CK (4.18); TCK (4.15); PK (3.99); TPK (3.92); TPACK (3.69); and TK has the lowest mean score of 3.63.The data help us understand that at the present challenges of the overwhelming pandemic, teachers showed higher level of knowledge on PCK suggesting that teachers are more into relating themselves with the necessary pedagogical efficiency coupled with their mastery of the content in their respective fields of expertise.

Additionally, educators in the premise of the study value and expand their perspectives of being specialists who use technology to enhance subject matter teaching skills which greatly supported by the foundations of TPACK by Mishra and Koehler (2006). They are also commited to high-quality professional development aimed at furthering their knowledge. Similar to the result of this study, Ertmer and Ottenbeit-Leftwich (2018) assert that there is a strong cohesiveness between that of pedagogy blended with Content Knowledge domain. In Sahin's (2016) 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. (2019), 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). As a result, in order for teachers to achieve successful technological integration in sync with evolving technology, some competencies such as 21st century skills/abilities have become necessary (Cox, 2008).

3.3 Correlation Analysis of the variables

The correlation analysis of the relationship between teachers' instructional technostress and TPACK-21 and demographic variables is summarized in Table 3.

The correlation result that science teachers revealed high significant relationship with 21st Century Technological Pedagogical and Content Knowledge (TPACK-21) r = - 0.58 ($p<0.038$). Its measured variables like Technological Knowledge (TK-21) r = - 0.10 ($p<0.043$); Pedagogical Knowledge (PK – 21) r = 0.82 ($p<0.025$); and Technological Pedagogical Knowledge r = - 0.78 ($p<0.047$). This indicates that as the TPACK-21 increases, the level of technostress decreases.

Table 3. Correlation analysis on Teachers' Technostress in TPACK-21

VARIABLES	CORRELATION EFFICIENT (r)	PROBABILITY (p)
21st Century Technological Pedagogical and Content Knowledge (TPACK-21)	- 0.58	0.038*
Technological Knowledge (TK – 21)	- 0.10	0.043*
Pedagogical Knowledge (PK – 21)	0.82	0.025*
Technological Pedagogical Knowledge (TPK – 21)	- 0.78	0.047*

*correlation is significant at the 0.05 level (2-tailed)

It has revealed that the TPACK-21 of teachers had negative significant effects on technostress except for pedagogical knowledge (PK-21). These findings coincide with the results of Ozgur (2020). This finding obtained can be interpreted as when there is a decrease in TPACK-21 particularly TK-21 and TPK-21, an increase in the technostress level of teachers will likely to happen (Joo, Lim and Kim, 2016). On the other hand, Ozgur (2020) stated that teachers' stress related to computer use is decreased when their perceived level of TPACK competency rises, vice versa. It indicates that TPACK is a key factor in coping with the technology-induced psychological stress called technostress, which is caused by the technologies that teachers use in their educational process. Dong et al. (2019) showed a positive relationship between Pedagogical Knowledge (PK-21) and teachers' technostress. The findings obtained that the increase in teachers' Pedagogical Knowledge (PK-21) competence reduces the stress related to the use of technological devices in the teaching-learning process.

3.4 Predictor variables on Teachers' Technostress

Table 4 presents the Regression Model of the study where it measured the impact of influence upon the dependent variables. In general, multiple regression gives this study the ability to describe, explain, and investigate the influence of numerous independent or multiple predictor variables on the variable that is being studied (the dependent variable). In this section, we investigate the extent to which independent variables including teachers' 21st Century Technological Pedagogical and Content Knowledge (TPACK-21) and demographic variables.

Table 4. Regression analysis between teachers' TPACK-21 and Technostress

	Unstandardized Coefficients		Standardized Coefficients		
Model	B	Std. Error	Beta	T	Sig.
(Constant)	5.354	0.000			
PCK_21	0.294	0.000	0.125	3.29	0.008**
TCK_21	-1.079	0.000	-0.677	4.97	0.038**
TPACK_21	0.290	0.000	0.794	4.18	0.000**
R = 0.83	R^2 = 0.69	F-Value = 4.114	SIG. = .043		

It reveals the variables that best predict high school teachers' technostress. Among the nine (9) independent variables, there were only three (3) variables that were found to be statistically significant predictors of teachers' technostress namely: PCK_21 (Beta=0.294), TCK_21 (Beta=-1.079), and TPACK_21 (Beta0.290). Since the Beta value of TCK is negative unlike PCK_21 and TPACK_21, it indicates that there is a tendency for the technostress to decrease as the Technology Content Knowledge of teachers increases.

The value of the coefficient is the amount by which the mean of the dependent variable shifts in response to a change of one unit in the independent variable, with all other variables in the model being unchanged (Jim, 2022). Moreover, beta (β) measures how strongly each predictor (independent) variable affects the criterion (dependent) variable. Standard deviations measure beta. A beta value of -.095 means that a one-standard-deviation change in the predictor variable will result in a 2.5-standard-deviation change in the criterion variable (Patorai, 2016). Thus, the predictor (independent) variables affect the criterion (dependent) variable more as beta increases. The standard deviation in teachers' technostress will increase by 0.125 if TPACK-21 increases by 0.125.

Based on the prior investigation, the equation that is helpful in predicting the teachers' technostress (Y), as evidenced by the F value of 4.114 and its related probability value of 0.043, is statistically significant when p is less than 0.05. The following examples show this model:

Y=5.354 + 0.294 X1 -1.079 X2 + 0.290 X3

Where:

Y= Teacher's technostress
X= variables
X1 = Pedagogical Content Knowledge (PCK)
X2= Technological Content Knowledge (TCK)
X3 = Technological Pedagogical and Content Knowledge

Given that the overall influence of the three variables on the teachers' technostress was 69% ($R^2 = 0.069$), this study provides a window for the DepEd Division of Bukidnon administrators to revisit and examine the implementation and training of teachers to boost their self-efficacy based on the status of teachers' technostress. In line with prior research, the predictive power of TPACK_21 was found to be significantly larger than the comparable power of PCK_21 and TCK_21 in the situation being studied.

These findings support the study conducted by Koehler, Shin & Mishra (2011) that although it's challenging to properly accomplish goals while using technology to teach, the capacity of an educator to negotiate the spaces established by the three parts of content, pedagogy, and technology, as well as the intricate interactions among these aspects in specific settings, is the key to finding answers.

4. CONCLUSIONS AND RECOMMENDATIONS

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

The findings of the research showed that teachers' technostress is 3.07 for techno-overload, 2.61 for techno-complexity, 2.33 for techno-insecurity, and 3.51 for techno-uncertainty. Mean score technostress for teachers is 2.89, which corresponds to "moderately affected by stress."

A "High level of knowledge" in the overall TPACK-21 efficacy among the high school teachers of the Divisions of Bukidnon and Valencia City has been very evident in the study as shown in the grand mean of 3.97. Likewise "High level of knowledge" was also obtained among all of the seven (7) knowledge domains: PCK has the highest mean score of 4.20; followed by CK (4.18); TCK (4.15); PK (3.99); TPK (3.92); TPACK (3.69); and TK has the lowest mean score of 3.63.The data help us understand that at the present challenges of the overwhelming pandemic, teachers showed higher level of knowledge on PCK suggesting that teachers are more into relating themselves with the necessary pedagogical efficiency coupled with their mastery of the content in their respective fields of expertise.

The data exposed high significant relationship with 21st Century Technological Pedagogical and Content Knowledge (TPACK-21) $r = -0.58$ ($p<0.038$). Its measured variables like Technological Knowledge (TK-21) $r = -0.10$ ($p<0.043$); Pedagogical Knowledge (PK – 21) $r = 0.82$ ($p<0.025$); and Technological Pedagogical Knowledge $r = -0.78$ ($p<0.047$). The study indicated that as the TPACK-21 variables increase, the level of technostress decreases.

Pedagogical Content Knowledge, Technological Content Knowledge, and the Technological Pedagogical and Content Knowledge are the three (3) predictor variables that were derived from the data that was made available as an outcome

of the inquiry. Given that the overall influence of the three variables on the teachers' technostress was 69% (R^2 = 0.069), this study provides a window for the DepEd Divisions of Bukidnon and Valencia City administrators to revisit and examine the implementation and training of teachers to boost their teaching efficacy based on the status on technostress as related to their 21st Century Technological Pedagogical and Content Knowledge.

The secondary public teachers of the Department of Education - Bukidnon and Valencia City divisions in the Province of Bukidnon, Philippines are encouraged to avail of virtual trainings and seminars on how they can improve their efficacy on the knowledge domains of technology. Trainings and seminars in the planning, designing and implementation of effective online learning environments may be given to the teachers to improve their efficacy in the teaching coupled with technology utilization and lessen technostress.

Likewise, trainings for teachers during INSET and during LAC sessions may consider putting emphasis on the sharing of skills, knowledge and competences in the areas of Pedagogy, Content and Technology. These activities should consider allowing younger generations of teachers to mingle with each other and allowing them too to "mentor" or "guide" traditional and/or conventional teachers in utilizing technological tools for instruction and assessment.

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