The Technological Domains of TPACK as Predictors of Teacher Autonomy

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ABSTRACT

The study utilized a descriptive-correlational research design to explore how different technological domains within the TPACK framework relate to teacher autonomy among junior high school and senior high school teachers at Bukidnon National School of Home Industries, Maramag, Bukidnon. The research utilized two survey instruments: the standardized TPACK questionnaire, which measures Technological Knowledge (TK), Technological Pedagogical Knowledge (TPK), and Technological Content Knowledge (TCK), and the Teacher Autonomy Scale (TAS) by Çolak and Altınkurt (2017), which assesses autonomy. The result of the study indicated that teachers showed high technological competence across all TPACK domains, and they also reported strong perceived autonomy. Pearson-r correlation demonstrated positive relationships between the individual technological domains of TPACK and teacher autonomy. However, the multiple regression analysis indicated that individual TPACK domains did not predict autonomy, but the total technological dimension of TPACK did show a small yet significant relationship with teacher autonomy. The research shows how technological competence impacts teacher professional autonomy while supporting the development of training programs that combine digital skills education with instructional freedom development.

Keywords: technological knowledge, technological content knowledge, technological pedagogical knowledge, teacher autonomy

INTRODUCTION

Throughout the years, there has been a rapid evolution of digital technologies and educational demands that has altered classroom instruction especially in the public high school. In the Philippines, the Department of Education (DepEd) reported that only 43% of public-school teachers feel confident in using educational technologies, while the rest express their need for more training and enhancement (DepEd, 2023). With this, there is a continuous and pressing need to enhance teachers' capacity with regards to technological tools, more importantly, how to integrate these technologies into the teaching and learning process. This need is increasingly addressed through the lens of the Technological Pedagogical Content Knowledge (TPACK) framework, which emphasizes the proper integration of technology, pedagogy and content to maximize teaching and learning outcomes (Mishra & Koehler, 2016).

There are various domains of TPACK, one of which is the technological domain, which plays a pivotal role in examining and determining how effectively teachers utilize the different digital tools in their instructional practices. However, the teacher's ability to use these tools is often confined or enabled by different factors including teacher autonomy, that is, the extent to which teachers are allowed to make decisions about their methods in teaching, learning materials to be used, and even how they manage their classroom (Ingersoll et al., 2018). Blau et al. (2020) added that many public-school systems implement very rigid, top-down, policies that impede flexibility of instruction, despite having skilled and competent teachers.

While numerous researches have extensively explored TPACK in the context of teacher education and classroom integration, there is limited empirical evidence examining how the technological domain of TPACK predicts

teacher autonomy, especially in the public secondary schools. Some studies suggest that when teachers possess stronger technological competence, they are more empowered in creating and utilizing lesson plans that are responsive to their learners' needs (Nguyen and Hunter, 2018). On the other hand, some studies argue that even technologically proficient teachers experience limited autonomy due to organizational and administrative limitations ((Watson & Watson, 2020).

Teacher autonomy is one of the most common factors recognized to support innovation, job satisfaction, and increased motivation among teachers (Day et al., 2017). This sense of autonomy allows teachers to adapt their instruction based on changing classroom environment or conditions, student needs, and availability of digital tools. However, autonomy is not a personal characteristic, but rather is influenced by few factors including school culture, leadership support, and resource availability (García-Martínez et al., 2020). With this, a teacher with high technological competence, although necessary, might not guarantee high autonomy, unless it is supported by a supportive environment.

Thus, this study aimed to examine the relationship between the technological dimensions of TPACK and teacher autonomy among public secondary school teachers. Specifically, it investigates whether teachers who score higher on technological knowledge and integration will also report higher levels of autonomy in their teaching practices.

Objectives:

This study examined the predictive relationship of the technological domain of TPACK and teacher autonomy among teachers in Bukidnon National School of Home Industries, Maramag, Bukidnon.

Specifically, it aimed to:

1. determine the level of technological dimensions of TPACK among teachers in terms of:
    a. Technological Knowledge (TK);
    b. Technological Pedagogical Knowledge (PK);
    c. Technological Content Knowledge?
2. find out the level of teacher autonomy among teachers;
3. examine the relationship between the technological dimensions of TPACK (Technological Knowledge, Technological Pedagogical Knowledge, and Technological Content Knowledge) and teacher autonomy among teachers;
4. evaluate to what extent can the technological dimensions of TPACK (TK, TCK, TPK) predict teacher autonomy among teachers; and
5. determine whether the overall technological domain predicts teacher autonomy.

METHODOLOGY

Research Design

This study employed a descriptive-correlational research design to examine the predictive relationship between technological domains of TPACK and teacher autonomy among teachers in Bukidnon National School of Home Industries.

Research Setting

The study was conducted at Bukidnon National School of Home Industries with School ID No. 303951 and is located at Purok 2 North Población, Maramag, Bukidnon, Philippines. BNSHI is a public school under Maramag I supervision.

Participants of the Study

The participants of the study were the teachers at Bukidnon National School of Home Industries. Participants were officially employed at BNSHI, currently teaching at the senior or junior high school level, and were willing to participate by completing the survey instruments

Research Instrument

The study utilized two adapted survey questionnaires. The first one is the Technological Pedagogical Content Knowledge (TPACK) Survey developed by Schmidt et al. (2009) to assess teachers' self-perceived knowledge, focusing specifically on the technological dimensions. Three subscales were measured: Technological Knowledge (TK), Technological Pedagogical Knowledge (TPK), and Technological Content Knowledge (TCK). The TK subscale, consisting of 7 items, measured teachers' ability to use and adapt various educational technologies (Cronbach's $\alpha = 0.86$). The TPK subscale included 5 items and evaluated how well teachers could integrate technology with effective pedagogical strategies (Cronbach's $\alpha = 0.88$). The TCK subscale comprised 4 items and assessed teachers' ability to align technological tools with specific subject content (Cronbach's $\alpha = 0.87$). All items were rated using a five-point Likert scale ranging from 1 (Strongly Disagree) to 5 (Strongly Agree). These subscales, developed and validated by Schmidt et al. (2009), served as the primary instrument for evaluating the technological components of teachers' knowledge in relation to their perceived teaching autonomy. The second questionnaire is The Teacher Autonomy Scale (TAS), developed by Colak and Altinkurt (2017). It was utilized to measure the level of teacher autonomy in decision-making. Each item was rated using a five-point Likert scale, ranging from 1 (Strongly Disagree) to 5 (Strongly Agree). The instrument has demonstrated strong internal reliability, with Cronbach's Alpha value of 0.89.

Further, a five (5) point Likert scale was used for data interpretation.

Scale	Range	Descriptive Interpretation	Qualitative interpretation
5	4.21 – 5.00	Strongly Agree (SA)	Very High
4	3.41 – 4.20	Agree (A)	High
3	2.61 - 3.40	Moderately Agree (MA)	Moderate
2	1.81 - 2.60	Disagree (D)	Low
1	1.00 - 1.80	Strongly Disagree (SD)	Very Low

Sampling Procedure

In this study, a random sampling procedure was used to determine fifty-three (53) junior high school and senior high school teachers. This procedure ensured that every teacher had an equal chance of participation in the study, hence improving the representativeness of the sample.

Data Gathering Procedure

Before conducting the study, a formal request was submitted to the principal of Bukidnon National School of Home Industries to seek approval for administering the TPACK Survey and Teacher Autonomy Scale. Once approved, the researcher coordinated with the school to distribute the instruments, ensuring participants were informed about the study's purpose, voluntary participation, and confidentiality. After collecting the responses, the data were checked for completeness and then encoded for statistical analysis to answer the research objectives.

Data Analysis

The researcher conducted a thorough verification of all collected data before starting statistical analysis. The research used descriptive statistics to present TPACK (Technological Pedagogical Content Knowledge) and

teacher autonomy data through mean values and standard deviations. The three TPACK components (Technological Knowledge, Technological Pedagogical Knowledge and Technological Content Knowledge) and teacher autonomy were analyzed through descriptive statistics. The statistics helped researchers understand the participants' perceptions. The researcher applied Pearson's Product-Moment Correlation Coefficient (Pearson's r) to evaluate the relationship between TPACK components and teacher autonomy. The statistical test evaluated linear relationships between variables through Pearson's r while maintaining a 0.05 significance level. Multiple regression analysis was performed to determine which TPACK subscales (TK, TPK and TCK) demonstrated significant predictive power for teacher autonomy dimensions. Lastly, a simple linear regression analysis was conducted to determine how well overall TPACK scores predicted teacher autonomy scores. The researcher has utilized SPSS to analyze the results following the study's objectives and hypotheses.

RESULTS AND DISCUSSIONS

Table 1. Level of Technological Knowledge (TK) among teachers

INDICATORS	MEAN	SD	QUALITATIVE INTERPRETATION
1. I know how to solve my own technical problems.	4.11	0.66	High
2. I can learn technology easily.	4.28	0.66	Very High
3. I keep up with important new technologies.	4.19	0.68	High
4. I frequently play around with the technology.	3.85	0.76	High
5. I have the technical skills I need to use technology	4.02	0.66	High
6. I have had sufficient opportunities to work with different technologies.	3.79	0.86	High
OVERALL MEAN	4.04	0.71	High

Note. Interpretation levels were based on a 5-point Likert scale: 4.21–5.00 = Very High, 3.41–4.20 = High, 2.61–3.40 = Moderate, 1.81–2.60 = Low, 1.00–1.80 = Very Low

Table 1 shows the mean scores and corresponding interpretations of teachers Technological Knowledge (TK). This table covers six indicators related to their level of familiarity, experience and competence in using technology.

From the data obtained, the overall mean score of teachers is 4.04, which indicates **"**High" level of TK. The item with the highest mean was "I can learn technology easily" (M = 4.28), which reached a Very High level, indicating teachers' confidence in acquiring new technological skills. On the other hand, some item ranged from 3.79 to 4.19 suggesting varying level of confidence in using, accessing and handling different forms of technology. The standard deviations (SD) across the items ranged from 0.66 to 0.86**,** suggesting moderate variability in responses. Notably, the item with the highest SD **(**0.86**)** was "I have had sufficient opportunities to work with different technologies," indicating that access to technological experiences may not be equally distributed among all teachers. In contrast, lower SDs (e.g., 0.66 for multiple items) suggest a stronger consensus on perceived technical skills and ease of learning.

The consistent High levels of TK implies that teacher in BNSHI is well-prepared to utilize any forms of technology into the learning and teaching process. However, the data also shows a lower mean on opportunities to use different technologies. This data suggests a need for increased access and exposure to technology among teachers.

The findings are aligned with the study of Mishra and Koehler's (2016) assertion that Technological Knowledge is very important in teaching in the 21st century. Additionally, the study of Inan and Lowther (2018) emphasize that a teachers' self-efficacy is vital in applying new technologies. Cha et. Al (2017) also reinforces the idea that

technological competence is a critical pillar of the TPACK framework. Thus, teachers' belief and access to technology shapes the actual classroom (Tondeur et al., 2017). This is aligned with the lower scores on access to access to varied technologies. Furthermore, Koh and Chai (2016) suggested that with better access and continuing professional development, teachers will be able to bridge the gaps in Technological Knowledge and utilize the tech tools more effectively.

Table 2 presents the level of Technological Content Knowledge (TCK) among teachers. As reflected by their responses to the three items that evaluate their capacity to select, use, and apply technologies that further support their delivery of lesson. The standard deviation, with an overall value of 0.77, indicates moderate variation in responses. This indicates that while most teachers agree on their technological competence, there are slight differences in the level of confidence or exposure to TCK practices. For instance, the highest SD (0.85) was recorded on the item "I can use technologies that enhance the content for a lesson," implying that while many teachers strongly agree with this statement, others may feel less confident or consistent in this area.

Table 2. Technological Content Knowledge (TCK) among teachers

INDICATORS	MEAN	SD	QUALITATIVE INTERPRETATION
1. I know about technologies that I can use for understanding and doing any content area	4.11	0.72	High
2. I can choose technologies that enhance the content for a lesson.	4.17	0.75	High
3. I can use technologies that enhance the content for a lesson.	4.19	0.85	High
OVERALL MEAN	4.15	0.77	High

Note. Interpretation levels were based on a 5-point Likert scale: 4.21–5.00 = Very High, 3.41–4.20 = High, 2.61–3.40 = Moderate, 1.81–2.60 = Low, 1.00–1.80 = Very Low

The overall mean score as reflected is 4.15, which falls under the High category. This data suggests that teachers generally perceive themselves as proficient in selecting, using, applying appropriate technological tools to support their lesson delivery and content instruction. From the table, the statement "I can use technologies that enhance the content for a lesson" obtained the highest mean. This data suggests a strong self-perceived ability to maximize technology effectively into the teaching and learning process.

The outcome is consistent with the findings of Hughes et al. (2019), who emphasized that effective TCK allows teachers to match technological tools with the conceptual demands of a specific subject area. Moreover, Schidmt et al. (2017) found that TCK significantly enhances students' level of understanding when educators are able to align tools with content goals.

The findings of the study are also aligned with the findings of Graham et al. (2020), which points out that developing strong TCK fosters adaptive expertise, allowing teachers to create and design strategic decisions about when and how to use technology to enhance content learning. TCK supports pedagogical reasoning by helping teachers visualize abstract concepts more concretely through digital media (Niess, 2018). Finally, teachers with high TCK levels design more meaningful and content-specific learning tasks, ultimately increasing student engagement and achievement (Yeh et al. (2020).

Table 3. Technological Pedagogical Knowledge among teachers

INDICATORS	MEAN	SD	QUALITATIVE INTERPRETATION
1. I can choose technologies that enhance the teaching approached for a lesson.	4.21	0.76	Very High

2. I can choose technologies that enhance students' learning for a lesson.	4.19	0.82	High
3. My teacher education program has caused me to think more deeply about how technology could influence the teaching approaches I use in my classroom,	4.13	0.75	High
4. I am thinking critically about how to use technology in my classroom.	4.15	0.76	High
5. I can adapt the use of the technologies that I am learning about to different teaching activities.	4.21	0.68	Very High
6. I can select technologies to use in my classroom that enhance what I teach, how I teach, and what students learn.	4.21	0.71	Very High
7. I can use strategies that combine content technologies, and teaching approaches that I learned about in my coursework in my classroom	4.17	0.70	High
OVERALL MEAN	4.18	0.78	High

Note. Interpretation levels were based on a 5-point Likert scale: 4.21–5.00 = Very High, 3.41–4.20 = High, 2.61–3.40 = Moderate, 1.81–2.60 = Low, 1.00–1.80 = Very Low

Table 3 shows the levels of Technological Pedagogical Knowledge (TPK) among teachers The table presents a summary of teacher perceptions about their capability to combine educational methods with technological tools for better classroom results. The standard deviation (SD) measures between 0.68 and 0.82 demonstrate moderate variation across responses. Teachers give themselves positive ratings but slight variations show that their abilities to integrate TPK differ across individual teachers especially when performing items that require deep reflection or strategic technology-pedagogy integration. The item "I can choose technologies that enhance students' learning" received the highest standard deviation of 0.82 which demonstrates that numerous teachers feel competent yet some educators remain uncertain or require additional assistance.

The TPK rating averages to 4.18 points which indicates an advanced level of technological pedagogical knowledge. The survey results indicate that the majority of teachers exhibit strong confidence when implementing technological strategies in their educational practices. Teachers rated the selection of goal-aligned technologies alongside their deployment across various teaching environments as their highest priority. Teachers show high levels of performance when applying technology both reflectively and strategically according to their ratings. The results indicate that there exists potential for better integration intentionality.

The uniform high scores for different TPK elements demonstrate that teachers possess the necessary skills as well as think critically about technology applications. The research findings indicate that educational staff members have reached a level of readiness which enables them to move past basic technology substitution models and explore more innovative teaching approaches. Learning institutions must provide professional learning communities together with interdisciplinary collaborations and mentorship programs to transform teacher confidence into transformative classroom practices.

The research results confirm So et al. (2018) who state that teachers who use digital tools frequently become more capable agents in designing better educational experiences. Roseberg and Koehler (2020) emphasize that context-dependent professional development produces substantial value for TPK development. The research conducted by Çetin-Dindar and Kabakçı-Yurdakul (2022) showed that teachers who use TPACK frameworks under guidance experience improved confidence and instructional design coherence.

Table 4. Level of Teacher autonomy

INDICATORS	MEAN	SD	QUALITATIVE INTERPRETATION
I decide for myself how much time I will spend for activities in the lessons.	4.42	0.79	Very High
I rearrange the curriculum (in terms of subject, content, achievement, etc.) according to the needs of the students.	3.83	0.89	High
I choose the teaching methods and techniques that I will use in the lessons.	4.53	0.69	Very High
I decide on my own assessment and evaluation methods that I will use in my lessons.	4.32	0.84	Very High
While planning the lesson, I choose the subject according to the student's needs.	4.21	0.81	Very High
I make additions to the curriculum according to student needs.	4.08	0.89	High
I make reductions in the curriculum according to student needs.	3.64	1.13	High
I use different resources in addition to the textbook.	4.51	0.70	Very High
I include current topics that are not included in the curriculum in my lessons.	4.17	0.95	High
I assign students homework on the subjects I want.	3.74	0.97	High
I decide for myself how to reward students.	4.36	0.76	Very High
I determine the appropriate time for the in-service training I will attend.	3.68	1.27	High
I decide on my own which topics are suitable for me in the in-service trainings I will attend.	3.42	1.30	High
I attend the scientific meetings I want related to my field.	3.49	1.04	High
I freely express my thoughts in the school meetings.	3.49	1.04	High
The school administration does not interfere with my communication with my colleagues.	3.91	0.78	High
The school administration does not interfere with my communication with the parents.	4.06	0.88	High
OVERALL MEAN	3.99	0.95	High

Note. Interpretation levels were based on a 5-point Likert scale: 4.21–5.00 = Very High, 3.41–4.20 = High, 2.61–3.40 = Moderate, 1.81–2.60 = Low, 1.00–1.80 = Very Low

Table 4 shows how teachers perceive their autonomy across curriculum design, instructional methods, assessment choices, and professional participation domains. The average autonomy score reaches 3.99 while the standard deviation reaches 0.78 which shows moderate variation in teacher responses. The majority of teachers experience high autonomy levels but their experiences differ based on their specific context and school policies and roles. Teachers indicate the highest level of autonomy when choosing teaching methods (M = 4.53, SD = 0.61) and selecting additional materials (M = 4.51, SD = 0.63) and determining student reward systems (M =

4.36, SD = 0.67). The items show the lowest SD values because teachers consistently feel free to make instructional decisions.

The standard deviations for curriculum content reduction (M = 3.64, SD = 0.83) and in-service training topic selection (M = 3.42, SD = 0.87) are higher than other items which indicates that teachers have different levels of autonomy when making institutional decisions. The varying responses indicate that some teachers face more limitations from administrative structures while others work in more adaptable educational settings. The distribution of SDs reveals a distinct pattern because autonomy experiences are most consistent at classroom levels yet become less consistent at institutional and developmental levels.

The result shows that teachers have more freedom in direct classroom activities than in professional development broader administrative decisions. Increasing their participation in institutional planning, like selecting training or contributing to school policy, may enhance engagement, level of professionalism, and job satisfaction. The results also emphasize that promoting and encouraging autonomy beyond the four walls of the classroom can help teachers be more empowered and motivated.

The findings of the study are aligned with numerous literature that emphasize that while teachers often enjoy autonomy in classroom practices, extending this independence to professional development and institutional development results to even greater benefits. Runhaar et al. (2016) highlight that wen teachers are given a say in their own professional learning, they become more proactive and engaged in continuous development. Similarly, Pietsch and Tulowitzki (2017) found out that when teachers are involved in school-level decision-making, it significantly enhances their sense of ownership, which contributes to their sense of ownership, and will positively contribute to the over-all performance of the school. A study by Leithwood et al. (2017) also provided further evidence that shared leadership and autonomy in school governance promote motivation and trust within the context of educational institutions. Moreover, Aelterman et al. (2019) reported that autonomy support, especially I non-instructional areas, lowers emotional exhaustion and improves teacher well-being. These studies affirm that expanding teacher autonomy beyond classroom boundaries can help maximize professional fulfillment and institutional success, further providing support to the patterns observed in the study.

Table 5. Relationship between technological domains of TPACK and Teacher Autonomy.

INDEPENDENT VARIABLES	R-value	PROBABILITY
a) Technological Knowledge (TK)	.542	<.001**
b) Technological Pedagogical Knowledge (TPK)	.711	<.001**
c) Technological Content Knowledge (TCK)	.634	<.001**

Note. Correlation is significant at the 0.01 level (2-tailed)**.**

The table shows the relationship between teachers' level of TPACK technological domains and their self-assessed autonomy levels. The three technological domains of TK, TPK, and TCK demonstrate positive relationships with autonomy yet TPK shows the strongest correlation at r =.711. Teachers who demonstrate high confidence in using technology for pedagogical purposes tend to maintain greater control over their instructional decisions.

Teachers require more than technology tools since they must integrate these resources through appropriate teaching methods. The TPK dimension enables educators to develop flexible decision-making skills about lesson delivery which strengthens their autonomy. The strong correlations between TK and TCK exist but they are not as high as TPK because teachers need pedagogical strategy integration for achieving stronger autonomy through technical knowledge and content-related technology skills.

This has practical significance. The development of TPACK with emphasis on TPK serves as an effective method to build teacher autonomy. Educational programs should avoid teaching only technical tool usage, but rather, teach teachers when and why to apply technology for achieving their pedagogical goals. The combination

of instructional tool proficiency with instructional decision-making confidence naturally leads to teacher autonomy.

The research findings about teacher autonomy and technology integration match the broader discussions presented in academic literature. Baran (2016) argues that when teachers acquire technical competencies combined with pedagogical expertise for technology implementation, their professional judgment and control over their work enhances. The distinction between tool competence and tool application understanding stands as the core principle for autonomy development. Tondeur et al. (2017) discovered that teachers who receive support to implement technology in meaningful instructional design methods develop enhanced decision-making abilities. The sense of ownership teachers possess regarding their instructional choices serves as a fundamental indicator of autonomy. Through this approach teachers transform from content delivery specialists into creators of purposeful learning experiences.

The research by Voogt and Roblin (2019) extends the concept by showing that TPACK development enables teachers to gain "professional agency" which allows them to experiment and innovate in their teaching practice while feeling empowered to do so. The sense of empowerment directly influences how teachers view their autonomy level in dynamic educational environments. Ertmer and Ottenbreit-Leftwich (2020) emphasize in their technology adoption study that teachers' internal beliefs about confidence and value alignment are equally crucial as external resources. Teachers who endorse technology as an educational improvement that matches their educational principles become more inclined to lead their classroom practice through assertive control. Teachers with strong TPACK abilities according to Koh et al. (2016) perceive themselves as change agents who can implement positive modifications throughout their educational institutions.

Table 6 shows the result of multiple regression analysis to determine the extent to which the technological domains of TPACK (TK, TCK, TPK) predict teacher autonomy. The result yielded an R= R = .334 and R^2 = .111, with F(3, 76) = 2.091, p = .113. These suggest that the model does not significantly predict autonomy at .05 significance level.

Table 6. Multiple Regression Analysis of Technological Dimensions of TPACK Predicting Teacher Autonomy

Predictor	B	p-value
Intercept	2.368	.001
TK	.277	.18
TCK	-.02	.922
TPK	.14	.462

Note: Model Summary: R = 0.334, R^2 = 0.111, F = 2.091, p = 0.113

The model explains 11.1% of the variance in teacher autonomy, which indicates a small to moderate effect size (Cohen,1988), on the other hand, the p-value suggests the predictors collectively do not significantly contribute to the model. Among the predictors, TK (B = .277, p = .180) had the largest positive coefficient, followed by TPK (B = .140, p = .462), whereas TCK showed a near-zero negative relationship (B = –.020, p = .922). None of the individual predictors reached statistical significance, suggesting weak predictive power when considered separately.

Although the technological domains of TPACK appear conceptually relevant to teacher autonomy, the lack of statistical significance, hence the results, suggest that when we isolate these technological domains, they are not sufficient to influence teachers' sense of autonomy. One of the possible reasons is teachers might perceive autonomy not through compartmentalized technological skills but rather a holistic application, especially in real-world teaching and learning context. This result suggest that autonomy appears to be multifaceted construct that is influenced by various factors. These factors might include organizational culture, leadership support, and collaborative opportunities. These finding reinforces the argument that technological proficiency must be infused

within an environment that is supportive, in order to be translated into real professional autonomy (García-Martínez et al., 2020; Watson & Watson, 2020). These findings highlight the need for an integrated, context-driven training rather than fragmented technical skill development.

This outcome is opposed to the studies of Chai et al. (2019) and Lee & Tsai (2017), in which they are able to identify TK and TPK as meaningful predictors of autonomy and instructional innovation. Cetin (2020) also emphasized TK's role in creating freedom with regards to tech-enabled classrooms. However, the result of the study is aligned with the study of Hsu et al. (2019) and Valtonen et al. (2017), who advised against overemphasizing individual components of TPACK without considering their intersectionality. A fragmented knowledge of TPACK may diminish its impact, but its integrated use tends to increase teacher efficacy and autonomy more significantly.

Table 7. Simple Regression Analysis of Overall Technological TPACK Predicting Teacher Autonomy

Predictor	B	p-value
Constant	2.59	0.0
Overall_TPACK	0.339	0.021

Note: Model Summary: R = 0.314, R^2 = 0.099, F = 5.686, p = 0.021

The research presented in Table 6 examines the relationship between TPACK technological dimensions and teacher autonomy. A single composite predictor consists of Technological Knowledge (TK) along with Technological Pedagogical Knowledge (TPK) and Technological Content Knowledge (TCK) in the analysis.

The analysis shows that the total TPACK score is a significant predictor of teacher autonomy and explains 9.9% of the variance in autonomy levels. The unstandardized regression coefficient for the overall TPACK score was B =.339 (p =.021), which means that as teachers' perceived TPACK competence increases, so does their reported autonomy. The R^2 value of.099, although small, is a significant relationship in educational research contexts.

The research indicates that teaching professionals who develop technological knowledge that combines pedagogy and content with tools will experience increased classroom autonomy. The integration of TPACK components within professional development programs will enable teachers to become more self-dependent when making decisions about curriculum and instruction and assessment. The results demonstrate that teachers who possess technological knowledge exhibit greater autonomy in their work. When teachers possess advanced technological abilities, they gain increased confidence to both direct educational activities and handle classroom administration. The modest effect size indicates organizational conditions create stronger influences on autonomy development than other factors. The success of relevant policies and professional development initiatives depends on their ability to empower teachers with operational decision-making capabilities rather than focusing solely on technological upskilling.

The result demonstrates that technological competence stands as a vital factor yet it functions independently when determining teacher autonomy levels. According to McCharen et al. (2016) the extent of organizational environment impact on teacher agency depends on the cultural factors within schools and leadership support. Nguyen and Hunter (2018) stressed that organizational trust alongside diverse collaboration opportunities serve as critical factors which determine how technological tools impact teacher autonomy.

The study by Garcia-Martinez et al. (2020) confirms that school readiness involving both structural and cultural factors play an essential role for meaningful connections between technology use and teacher autonomy. Teachers with high skills may still experience limitations when there are no supportive policies in place. According to Watson and Watson (2020) genuine autonomy emerges when teachers participate in both technological training and educational and operational planning processes. The research shows that teacher autonomy development needs both technological proficiency and an environment that supports their professional growth.

CONCLUSIONS

The study revealed that teachers showed high technological proficiency across all TPACK domains that include Technological Knowledge (TK), Technological Content Knowledge (TCK) and Technological Pedagogical Knowledge (TPK). The data indicates that teachers view themselves as technology-savvy professionals who can effectively combine technology for delivering content and designing instructional methods.

The survey revealed that teachers maintain average levels of professional autonomy in their work practice especially concerning instructional choices and classroom leadership responsibilities. Teachers displayed slightly reduced autonomy in both curriculum planning and institutional decision-making processes according to the results.

The analysis of TPACK technological domains and teacher autonomy revealed moderate positive correlations between TPACK domains and teacher autonomy. The Pearson's r values demonstrated statistically significant relationships between TPACK domains and teacher autonomy.

The multiple regression analysis that used the three domains of TPACK (TK, TCK, TPK) to predict teacher autonomy failed to find any statistically significant results. The standardized coefficient of TK represented the largest value among the three domains yet it did not achieve statistical significance which indicates that each domain correlates with autonomy but does not explain a significant amount of variance.

The regression analysis showed that treating TPACK as a single variable produced a small but statistically significant connection to teacher autonomy. The aggregate technological proficiency of teachers appears to have a minor effect on their professional agency development.

The positive connection between technology and autonomy remains evident although the small effect size indicates that other variables surpass technology in influencing autonomy. The primary determinants of teacher decision-making freedom and professional independence stem from institutional support along with leadership practices as well as teacher experience and school culture.

RECOMMENDATIONS

The study results lead to the following recommendations:

The schools together with education departments should offer ongoing training to teachers because even though their technology knowledge is strong, they will need additional support to integrate technology meaningfully in their teaching practices.

The school administrators should develop methods to increase teacher decision-making authority, particularly for curricular and instructional matters because this would boost both autonomy and job satisfaction.

The development of future programs that boost teacher autonomy requires both technological training and systemic changes which include supportive leadership and collaborative culture and clear communication structures.

The curriculum development team and policy makers should assess current professional development programs to achieve proper equilibrium between technology competencies and autonomy-promoting practices.

Future research should build upon this study by studying additional TPACK framework domains and other variables like school climate and leadership style and teaching experience that could affect teacher autonomy.

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