READINESS IN BLENDED TEACHING AND TPACK COMPETENCIES OF JUNIOR HIGH SCHOOL MATHEMATICS TEACHERS

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DOI: https://doi.org/10.54476/ioer-imrj/709965

ABSTRACT

Given students' technological proficiency, teachers need to be equally proficient in using technology to address learning needs and foster a technology-enhanced classroom. This is key to the study, which sought to determine the readiness of mathematics teachers in blended teaching and their TPACK competencies. It also explored the relationship between these two concepts, identified issues and challenges in blended teaching, and prepared a TPACK - based toolkit. Employing a descriptive-correlational research method, the study involved 111 junior high school teachers from private schools in the selected division of Batangas. Data were collected using a modified survey questionnaire. The findings indicate that teachers are highly ready in blended teaching relative to their disposition, online integration, data practices, and online interaction, though their readiness in personalizing instruction was found to be moderate. Furthermore, they are found to be highly competent across all areas of the TPACK framework. A statistically significant positive relationship was identified between their readiness in blended teaching and the overall TPACK competencies. In conclusion, they are well-prepared in blended teaching and possess the foundational competencies necessary for effective instruction in the digital age. Their higher TPACK competencies likely enhance their readiness for blended teaching. Despite preparedness, significant obstacles persist, and the proposed toolkit is expected to contribute to the success of blended teaching.

Keywords: blended teaching, junior high school mathematics teachers, teaching competencies, readiness, TPACK

INTRODUCTION

Mathematics teaching today prioritizes meaningful learning, a goal emphasized by the National Council of Teachers of Mathematics. Teachers support this by using all approaches that bring students to reasoning and inquiry. They even engage in professional development, adapting to new strategies and technological innovations. This is in accordance with the DepEd Order No. 016, s. 2023, emphasizing technology integration to achieve globally competitive education. This aligns with Mishra and Koehler's (2006) TPACK framework, highlighting the importance of modern educators to possess TPACK competencies, as quality mathematics teaching, demands subject matter expertise, sound pedagogy, and knowledge in technology. This advancement presents the 21st century education, necessitating teachers to embrace new roles and develop TPACK competencies to enhance their teaching.

Meanwhile, despite significant efforts in mathematics education, Filipino students continue to struggle in mathematics, as evidenced by their low performance in the 2018 National Achievement Test and 2019 TIMSS. While it is true that students must also actively contribute to their own math learning, the dedication of teachers to be more TPACK competent and ready for blended

teaching is crucial in influencing student outcomes.

The increasing technological proficiency 21st-century learners demand that mathematics teachers be technologically proficient as well. However, a gap often exists between students' digital expectations and teachers' ability to leverage technology effectively, which prompted the researcher to explore the relationship between TPACK competencies and readiness in blended teaching, to develop a TPACK-based toolkit to support teachers in blended teaching and help them be equipped with the skills to meet the needs of today's technologically inclined learners.

OBJECTIVES OF THE STUDY

This study sought to assist teachers in providing effective Mathematics instruction within a blended learning setting. Specifically, it aimed to 1) determine the level of their readiness in blended teaching relative to disposition, online integration, data practices, personalizing instruction and online interaction; 2) ascertain their TPACK competencies in terms of content knowledge, pedagogical knowledge, and technological knowledge; 3) find out the relationship between the teacher's level of readiness in blended teaching and their TPACK competencies; 4) identify the issues and challenges in blended teaching; and 5) prepare a TPACK – based toolkit in blended teaching of JHS Mathematics.

METHODOLOGY

A descriptive – correlational method of research is employed in this study. It involved 111 Junior High School Mathematics teachers from private schools in Batangas. All participants were employed during the AY 2023-2024 and had blended teaching experience. From a total population of 154 teachers, 111 were selected using stratified random sampling, with 31 teachers in Schools Division Office (SDO) 1, 46 teachers in SDO 2, 24 teachers in SDO 3 and 10 teachers in SDO 4. The data were gathered using a modified questionnaire tailored from instruments by Graham et al. (2022), Powell et al. (2014), Catibog (2022), and Anakpua et al. (2023). The collected responses were then analyzed statistically.

RESULTS AND DISCUSSION

1. Mathematics Teachers' Readiness in Blended Teaching.

1.1 Disposition

Table 1 has revealed their openness to explore new blended approaches (WM = 3.77, SD = 0.49), aligning with the study of Salas - Catarman et al. (2024), who found that teachers were eager to adopt new blended learning strategies in math education.

Teachers also demonstrated strong openness in integrating technology into their lessons (*WM* = 3.66, *SD* = .48) and using student data to assess teaching effectiveness (WM = 3.64, SD = .49), findings aligned with the studies of Nuñeza (2024) and Paolucci et al. (2024), highlighting teachers' technological readiness and the value of using data to improve learning outcomes.

Table 1
Mathematics Teachers' Readiness in Blended Teaching relative to Disposition

	WM	SD	VI
As a Mathematics teachers, I am…			
1. comfortable exploring new strategies that combine in-person and online learning.	3.77	0.49	Strongly Agree
2. open to ensuring active engagement in discussions to create better learning experiences in blended environments.	3.68	0.47	Strongly Agree
3. confident in my ability to use learners' data to inform them about their own learning progress in blended teaching.	3.56	0.52	Strongly Agree
4. open to fostering collaboration among students in blended environments.	3.72	0.47	Strongly Agree
5. open to providing activities integrated with technology.	3.66	0.48	Strongly Agree
6. willing to regularly use learners' data to assess my blended teaching effectiveness.	3.64	0.49	Strongly Agree
Composite Mean	**3.67**	**0.33**	Strongly Agree/ Highly Ready

Generally, teachers are highly ready, as the composite mean of 3.67 suggests a notably positive perspective toward this model, aligning with the findings of Villanueva (2022), which reported an optimistic view regarding blended teaching.

1.2 Online Integration

Table 2 showed that respondents strongly agreed they can determine which student work should be done online and in-person (*WM* = 3.67, *SD* = .47). Gensen et al. (2024) noted that connection between online activities and in – person learning creates blended teaching.

Table 2
Mathematics Teachers' Readiness in Blended Teaching relative to Online Integration

	WM	SD	VI
As a Mathematics teachers, I can…			
1. decide when and how to integrate video conferencing tools in class discussions.	3.59	0.51	Strongly Agree
2. determine which lesson should be taught online and in-person.	3.63	0.49	Strongly Agree
3. determine which student work should be done online and in-person.	3.67	0.47	Strongly Agree
4. decide when and how to use online quizzes to assess student's learning.	3.56	0.52	Strongly Agree
5. determine when and how to use online interactive activities in practicing their skills.	3.52	0.52	Strongly Agree
6. decide when and how to integrate variety of online collaborative project platforms for group works.	3.55	0.52	Strongly Agree
7. decide when and how to provide online and in – person options for delivering instruction.	3.60	0.54	Strongly Agree
8. determine ways to make learning materials available online and in-person.	3.63	0.52	Strongly Agree
Composite Mean	**3.59**	**0.35**	Strongly Agree/ Highly Ready

They also strongly agreed they can integrate various online collaborative project platforms for group work (*WM* = 3.55, *SD* = .52), which reinforces the value of incorporating collaborative activities, as noted by Alvarez (2020).

Generally, they are highly ready to teach in a blended setting, with a composite mean of 3.59. This aligns with Cahapay et al. (2020), where teachers also recognized the suitability of integrating traditional and online instruction for their students.

1.3 Data Practices

Based on Table 3, respondents strongly agreed they can use assessment results to evaluate the effectiveness of their instruction (*WM* = 3.60, *SD* = .54). As highlighted by Umugiraneza (2017), criticisms of weak performance in mathematics often raise concerns about the effectiveness of instruction.

Table 3
Mathematics Teachers' Readiness in Blended Teaching relative to Data Practices

	WM	SD	VI
As a Mathematics teachers, I can…			
1. inform students about their learning progress using online and offline assessment results.	3.56	0.56	Strongly Agree
2. determine the students who are close to achieving mastery through online assessment results.	3.57	0.58	Strongly Agree
3. check student participation in online activities through the LMS' dashboards.	3.55	0.60	Strongly Agree
4. organize assessment results to identify which students have achieved mastery and could help peers.	3.52	0.62	Strongly Agree
5. use online assessment results to check who consistently performs well and who needs additional help.	3.47	0.66	Strongly Agree
6. use online and offline assessment results to evaluate the effectiveness of instruction.	3.60	0.54	Strongly Agree
7. identify which specific lesson the students are struggling with using assessment results.	3.56	0.58	Strongly Agree
8. identify patterns in small group and whole class learning using online and offline assessment results.	3.42	0.57	Agree
Composite Mean	**3.54**	**0. 44**	Strongly Agree/ Highly Ready

They also strongly agreed they can check student participation in online activities through LMS' dashboards (*WM* = 3.55, *SD* = .60).

Paajanen (2022) noted that low activity may signal at-risk students. They also strongly agreed they can organize test results to identify which students have achieved mastery and could help peers (*WM* = 3.52, *SD* = .5=62). As noted by Barnes et al. (2019), ranking scores allows high-achieving students to reinforce their knowledge while helping others improve understanding.

Meanwhile, they just agreed they can identify patterns using assessment results (*WM* = 3.42, *SD* = .57). Generally, they are highly ready in terms of data practices, with a composite mean of 3.54. This is valuable as Toropova et al. (2019) emphasized the link between data use and student success.

1. 4 Personalizing Instruction

Table 4
Mathematics Teachers' Readiness in Blended Teaching relative to Personalizing Instruction

	WM	SD	VI
As a Mathematics teachers, I can…			
1. use technology that gives students some choice in where they learn.	3.49	0.55	Strongly Agree
2. use technology that lets each of your students adjust their speed of learning.	3.38	0.63	Agree
3. combine individual or small group instruction with educational software to help each student succeed.	3.45	0.61	Strongly Agree
4. use educational software that adapts how each student progresses through lesson materials.	3.43	0.60	Agree
5. use online tools to make sure students learn material before moving on to the next lesson.	3.44	0.66	Agree
6. use technology that helps students see their progress towards goals they have set.	3.48	0.55	Strongly Agree
7. use technology that lets students choose how they show what they learned.	3.41	0.61	Agree
8. develop a set of online and offline resources to give students choice on how they learn.	3.40	0.64	Agree
Composite Mean	**3.44**	**0.46**	Agree/ Moderately Ready

Based on Table 4, respondents strongly agreed they can use technology that gives students some choice in where they learn (WM = 3.49, SD = .55) and helps them see their progress towards goals they have set (WM = 3.48, SD = .55). As emphasized by Attard and Holmes (2020), the diverse learning pathways offered by technology enhances student engagement.

Meanwhile, they agreed they can use online tools to make sure students learn material before moving on to the next (*WM* = 3.44, *SD* = .66) and educational software that adapts how each progress through materials (*WM* = 3.43, *SD* = .60). As implied by Anakpua et al. (2023), this accommodates various learning speeds. They also agreed they can develop a set of resources to give students a choice on how they learn (*WM* = 3.40, *SD* = .64). Kadirbayeva et al. (2022) emphasize how teachers see the value of varied resources in blended teaching. With a composite mean of 3.44, they generally are moderately ready in terms of personalizing instruction. As evidenced by the study of Ursua, J. (2023), personalized instruction results improved involvement.

1.5 Online Interaction

Table 5
Mathematics Teachers' Readiness in Blended Teaching relative to Online Interaction

	WM	SD	VI
As a Mathematics teachers, I can…			
1. establish clear expectations for respectful online communication between students.	3.41	0.64	Agree
2. communicate online while still maintaining professional student – teacher relationships.	3.58	0.55	Strongly Agree
3. facilitate productive interaction through the LMS' discussion forums.	3.42	0.60	Agree
4. use online communication to help strengthen students' feeling that they belong to the class.	3.50	0.65	Strongly Agree
5. give quick online feedback to students in a variety of ways using text, audio, or video.	3.54	0.60	Strongly Agree
6. help students use video conferencing tools for online discussions effectively.	3.50	0.57	Strongly Agree
7. help students work well in small groups both online and in – person.	3.50	0.55	Strongly Agree
8. give students a chance to help each other using online technology.	3.41	0.61	Agree
Composite Mean	**3.48**	**0.44**	Strongly Agree/ Highly Ready

Table 5 shows that teachers strongly agreed they can communicate online while still maintaining professional student – teacher relationships. (*WM* = 3.58, *SD* = .55), aligning with the findings of Cuccolo et al. (2024) about the value of teacher - student connections.

They also strongly agreed they can give quick online feedback to students in various ways (*WM* = 3.54, *SD* = .60). Timely feedback, as highlighted by Alvarez (2020), is important for fostering students' success in the course. Respondents also strongly agreed they can use online communication to help strengthen students' feeling of belongingness (*WM* = 3.50, *SD* = .65), a notion supported by Lin et al. (2013), whose study indicates that technology can boost students' social presence in online learning.

On the other hand, they agreed they can facilitate productive interaction through the LMS' discussion forums (*WM* = 3.42, *SD* = .60), contributing to social, cognitive, and teaching presence, based on the study of Padayachee et al. (2022). Generally, with a composite mean of 3.48, respondents are highly ready, a valuable finding, as lack of online interaction can negatively impact the learning process, based on the study of Hodges, et al. (2020).

2. TPACK Competencies of Junior High School Mathematics Teachers

2.1 Content Knowledge

Teachers are highly competent in answering math – related questions accurately (*WM* = 3.76, *SD* = .45), which aligns with Ma'rufi et al. (2018), who stresses the value of effectively responding to student inquiries.

They are also highly competent in demonstrating a mathematical way of thinking (*WM* = 3.74, *SD* = .44), a finding consistent with Patalinghug et al. (2021), who noted teachers' outstanding ability to apply mathematical thinking. Also, they are highly competent in effectively relating mathematical topics to everyday life (*WM* = 3.60, *SD* = .49). Isnaniah and Imamuddin M (2022) emphasize the need for teachers to be skillful in this area as math deals with abstract concepts.

Generally, a composite mean of 3.70 reflects their high level of content knowledge competency, a finding similar to that of Mansour et al. (2024).

2.2 Pedagogical Knowledge

The respondents are highly competent in assisting students in individual and collaborative works (*WM* = 3.78, *SD* = .44). Chiekezie and Ifeakor (2018) note that collaborative learning strategies boosts students' achievement. They are also highly competent in making lesson plans with engaging activities (*WM* = 3.68, *SD* = .47). This is an advantage because, as Anakpua et al. (2023) found, low student interest in mathematics is a challenge faced by teachers. They also have a high competency in using various teaching strategies in developing students' 21st century skills (*WM* = 3.67, *SD* = .47). This aligns with Campilla et al. (2021), who found that teachers used various 21st century strategies effectively.

Overall, respondents exhibited a high level of competency in pedagogy, with a composite mean of 3.72. This supports Lin et al. (2017), who found that blended learning enhances math achievement.

2.3 Technological Knowledge.

Teachers are highly competent in using word-processor programs (*WM* = 3.78, *SD* = .48), aligning with the findings of Pasayloon (2023) showing that the use of MS Word is the strongest technical skill for teachers. They are also highly competent in using spreadsheet programs and communication platforms (*WM* = 3.71, *SD* = .46). As Lalima and Dangwal (2017) pointed, computer-mediated communication promotes collaborative learning across distances.

They also show a high level of competency in using presentation tools (*WM* = 3.68, *SD* = .48). Mensah et al. (2021) found that students taught with PowerPoint performed better, highlighting its effectiveness. Meanwhile, they are moderately competent in using photo editing tools (*WM* = 3.49,

SD = .63), indicating basic skills in image enhancement.

Overall, a composite mean of 3.64 shows their high competency in technological knowledge. As emphasized by Alfrisa et al. (2020), successful blended learning requires thoughtful tech - integration into instructional design and practices.

3. Relationship between Mathematics Teachers' Readiness in Blended Teaching and their TPACK Competencies

The result indicates that there was a moderate, positive correlation between disposition and content knowledge ($p < .001$), pedagogical knowledge ($p < .001$) and technological knowledge ($p < .001$), suggesting that those possessing strong technological, content and pedagogical skills are more likely to have positive disposition towards blended teaching.

Table 6
Relationship between Mathematics Teachers' Readiness in Blended Teaching and their TPACK Competencies

Variables		r_s-value	Degree	p-value	Decision on H_o	Interpretation
Disposition	CK	.333	Moderate	<.001	Reject	Significant
	PK	.333	Moderate	<.001	Reject	Significant
	TK	.380	Moderate	<.001	Reject	Significant
Online Integration	CK	.554	Strong	<.001	Reject	Significant
	PK	.505	Strong	<.001	Reject	Significant
	TK	.499	Strong	<.001	Reject	Significant
Data Practices	CK	.629	Strong	<.001	Reject	Significant
	PK	.649	Strong	<.001	Reject	Significant
	TK	.648	Strong	<.001	Reject	Significant
Personalizing Instruction	CK	.651	Strong	<.001	Reject	Significant
	PK	.619	Strong	<.001	Reject	Significant
	TK	.581	Strong	<.001	Reject	Significant
Online Interaction	CK	.633	Strong	<.001	Reject	Significant
	PK	.628	Strong	<.001	Reject	Significant
	TK	.527	Strong	<.001	Reject	Significant

The relationship between online integration and TPACK competencies is also found to be statistically significant ($p < 0.001$), suggesting that teachers who are ready to teach online tend to have strong TPACK skills. This supports Qasem et al. (2016), who emphasized TPACK as a key measure of teachers' tech integration capabilities. There is also a significant relationship ($p < 0.001$) between teachers' TPACK competencies and their readiness for blended teaching in both data practices and personalizing instruction. Cui et al. (2022) highlight that effective teaching requires data literacy alongside technology, content, and pedagogy. A significant relationship ($p < 0.001$) also exists between their TPACK competencies and readiness in terms of online interaction, suggesting that the more knowledgeable they are in the content, the more ready they are to interact with students in a blended setting.

Short et al. (2021) note that increased online interaction makes digital citizenship and tools essential in blended teaching.

Generally, there is a strong link between teachers' readiness in blended teaching and their overall TPACK competencies, a finding similar to the study of Öztürk et al. (2024). This stresses that the stronger the TPACK competencies, the more ready teachers are for blended teaching.

4. Issues and Challenges in Blended Teaching

The increased workload placed the most considerable burden on mathematics teachers (*WM* = 3.10, *SD* = .75), supporting the same assertion of Adiguzel et al. (2020).

Lack of adequate planning and rigor is also their concern (*WM* = 3.05, *SD* = .77). Lalima and Dangwal (2017) noted that successful blended learning needs full support from educational authorities. They also faced challenges in the lack of internet facilities (*WM* = 3.01, *SD* = .87), which affected teachers in various areas, as noted by Anakpua et al. (2023).

However, difficulty in lesson planning for blended learning is seen as the most manageable aspect (*WM* = 2. 58, *SD* = .78). Generally, they still face a variety of challenges like limited ICT access, time constraints, slow internet, and funding issues, findings similar to Anakpua et al. (2023).

5. TPACK – based Toolkit in Blended Teaching of Junior High School Mathematics

To support JHS mathematics teachers in effectively implementing blended teaching, a TPACK - based toolkit has been prepared. Carefully crafted based on the study's findings, this toolkit provides them with a valuable set of resources, including detailed course outlines, teaching guide, engaging presentations, and practical worksheets, which aims to equip them

with the necessary tools and knowledge to support blended teaching, enhance essential competencies they need in fostering student academic achievement, and meet the needs of today's technologically inclined learners.

CONCLUSIONS

In the light on the foregoing findings, the following conclusions were drawn.

1. Mathematics teachers are highly ready to navigate the demands of blended teaching environments as they not only exhibit positive dispositions in its effectiveness but also excel at online integration, data practices, online interactions, and personalizing instruction.
2. Mathematics teachers are highly competent as they exhibit exceptional proficiency in aligning content, pedagogy, and technology in their teaching.
3. The greater the TPACK competencies possessed by mathematics teachers, the more they are in blended teaching.
4. Although challenges arise less often, mathematics teachers still encounter difficulties in blended teaching that negatively affect their teaching experience, necessitating solutions to ensure effective instruction in such environments.
5. A TPACK – based toolkit was prepared to support blended teaching and provide a significant positive impact on educators and the overall success of blended learning initiatives.

RECOMMENDATIONS

Based on the findings and conclusions, the following recommendations are put forth.

1. Educational institutions should prioritize professional development programs that focus on enhancing teachers' ability to personalize instruction and tech integration to meet the demands of blended teaching.
2. Senior high school teachers should explore the development of a teaching toolkit patterned to this study's output to support their blended teaching journey.
3. Researchers should further investigate other factors beyond TPACK competencies that significantly influence teachers' readiness for blended teaching to gain a deeper understanding of the challenges and opportunities involved in blended teaching.

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