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Cooperative learning implementation among elementary Trust School Teacher Program

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ABSTRACT

Malaysia's education system is continuously transforming to provide pupils with 21st-century skills. Cooperative learning is viewed as a student-centered approach that helps pupils develop 21st-century learner characteristics. This study aims to identify the relationship between teachers' content knowledge, pedagogical knowledge, and technological knowledge with the implementation of cooperative learning. A total of 100 elementary Trust School Program teachers in Selangor were involved in this quantitative study, which comprises a correlational design. Respondents were randomly selected to answer the teachers' cooperative learning questionnaire (TCLQ) and the content, pedagogical, and technological knowledge questionnaire. The findings obtained indicate that teachers' content knowledge, pedagogical knowledge, and technological knowledge are at a high level. No significant difference was reported between teachers' knowledge and implementation of cooperative learning based on years of teaching experience in Trust School Program. The result also revealed a positive and strong relationship between content knowledge and cooperative learning implementation (r=0.551, p=0.000), as well as a positive and strong relationship between pedagogical knowledge and cooperative learning implementation (r=0.603, p=0.000). However, a positive and moderate relationship was reported between teachers' technological knowledge and cooperative learning implementation (r=0.384, p=0.000). This study can help raise awareness about the elements that educational policymakers and educators need to take into account during cooperative learning.

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1. INTRODUCTION

It has become increasingly important to teach pupils with 21st-century skills. Cooperative learning is among the 21st-century learning approaches that enable pupils to learn together and support each other in small groups [1]. This approach has proven that it can enhance not only academic performance but also develop social interaction, leadership skills, and thinking skills [2]–[4]. Additionally, these skills are highly relevant in preparing learners to face 21st-century challenges [5]. Therefore, teachers, as key drivers of quality education, need to shift their teaching approach from conventional to student-centered. The Curriculum Development Department, Ministry of Education, has launched the Malaysia Education Blueprint (MEB) 2013-2025, third wave, to add an innovative teaching model that utilizes the student-centered approach by inculcating teachers. Besides, the Trust School Program (TSP) was developed via a

public-private partnership between the Ministry of Education (MOE) and Yayasan AMIR for its supervision in implementation and management, while LeapEd was developed as an education service provider. In 2022, there are a total of 57 elementary Trust School Programs in Malaysia. One of the strategic goals of the TSP is to improve the quality of teaching and learning. The TSP promotes effective pedagogies via continuous professional development (CPD) and introduces the cooperative learning approach to be embedded by all the teachers involved in the school culture.

An MEB 2013-2025 report in 2018 indicated that of the 1,476 teachers surveyed, only 399 (27%) achieved an "excellent" level in teaching, and 1,077 (73%) achieved only a "minimum good" level [6]. This finding revealed that most teachers are still comfortable practicing a teacher-centered teaching style. Previous study has shown that although cooperative learning strategies have been introduced to teachers, there is still a moderate level of application [7]. Besides, teachers have difficulties in implementing cooperative learning due to a lack of understanding of the strategy and embedding curriculums with cooperative learning implementation [8], and classroom management [9], [10]. Additionally, in this digital era of education, the integration of technology in teaching and learning approaches has a positive impact, especially in boosting pupils' maximum potential [11]. Prior studies have proven that teachers' abilities to integrate the use of technology in a student-centered teaching approach improve students' overall learning performance [12] and able to inculcate pupils' thinking skills [13]. However, experienced teachers still cannot adapt to using technology in class [14], while some mentioned that the use of technology is burdensome [15]. There is a need to study on factors that contribute to the implementation of cooperative learning especially in the context of elementary TSP teachers because the teaching and learning culture in elementary TSP emphasizes the implementation of cooperative learning.

View of the perspective of the implementation of innovation, knowledge is important and as core element of success [16]. Research on cooperative learning as innovation implementation among teachers remains to be limited. In Malaysia, previous research on the implementation of cooperative learning focused on cooperative learning effects on pupils in various subject areas such as the Malay language [17], science [2], Islamic studies [18], and home science [19] as well as on pupils' attitudes [20]. In our research, we focused on teachers' knowledge in implementing cooperative learning. Teachers who master content knowledge tend to choose a suitable teaching approach easily [21]. Content knowledge refers to teachers' knowledge of subject matters that need to be mastered by teachers and learned by pupils. Teachers' content knowledge is important in order to implement the student-centered teaching approach [22]–[24]. In contrast, however, a study [25] found that teachers tend to implement a traditional teaching approach although they have a high level of content knowledge. Therefore, the inconsistent finding drives us to study the correlation of teachers' knowledge in terms of content knowledge and implementation of cooperative learning.

Pedagogical knowledge influences teachers' implementation of student-centered teaching approaches [26]. Teachers' pedagogical knowledge comprises knowledge of teaching strategies, pupils' assessment, and classroom management [27]. Pedagogical knowledge correlate with a student-centered teaching approach [7], [28]. Conversely, a study [29] found a positive and weak relationship but did not reach a significant level between teachers' pedagogical knowledge towards the implementation of a student-centered approach. The situation is due to a lack of knowledge and experience among 66.6% of novice teachers in managing a student-centered approach. Therefore, it is vital to investigate teachers' pedagogical knowledge towards cooperative learning implementation, especially in the context of trust school teachers.

Teachers play a pivotal role in mastering technological knowledge to integrate technology into teaching and learning. According to Schmid *et al.* [30], teachers' technological knowledge refers to knowledge about standard technologies that range from basic technologies (e.g., books and whiteboards) to modern technology (e.g., the internet and digital videos), and how to operate them. Prior studies found that teachers' technological knowledge is associated with teaching practice [29], [31]. Besides, the results of studies on teachers' technological knowledge by teaching experience vary. Experienced teachers perceived their technological knowledge as higher than novice teachers [32], while some studies found that novice teachers' technological knowledge was higher than experienced teachers [33], [34].

This study combines the technological, pedagogical, and content knowledge (TPACK) model [35] and the Fullan's model [36] to structure the research framework. In this study, we focus on three core components from the TPACK, namely, content knowledge, pedagogical knowledge, and technological knowledge as the crucial knowledge for effective teaching. The aim of this study is to determine the relationship between teachers' content knowledge, pedagogical knowledge, technological knowledge, and cooperative learning implementation among Elementary Trust School Programme teachers in Selangor, Malaysia. Based on the previously introduced information, the authors propose the following hypotheses: There is a significant difference in the level of content knowledge, pedagogical knowledge, technological knowledge, and cooperative learning implementation in the years of service in TSP (H1); There is a significant relationship between content knowledge, pedagogical knowledge, technological knowledge, and cooperative learning implementation (H2).

2. RESEARCH METHOD

The study was conducted at an elementary Trust School Program in Selangor, because the number of elementary trust school teachers is the highest in Selangor in particular. Additionally, the teachers and pupils' ratio are also the highest in Selangor. The total number of elementary trust school teachers in Selangor is 546. This study applies a correlation design with a quantitative approach. The simple random sampling method was used, and the selection of the sample was conducted using a simple computerized random number. A questionnaire was employed as the primary instrument for data collection. The dependent variable in the study is the implementation of cooperative learning, while the independent variables are teachers' content knowledge, pedagogical knowledge, and technological knowledge.

In this study, the researchers used questionnaire instruments [37] to measure teachers' content knowledge (TCK), while the questionnaire [38] was used to measure teachers' pedagogical (TPK) and technological knowledge (TTK). Additionally, the Teachers' cooperative learning questionnaire (TCLQ) [39] to measure teachers' cooperative learning implementation. The questionnaire contains 42 items divided into five parts. Part A focuses on respondents' demographics, Part B (eight items from TCK), Part C (seven items from TPK), Part D (seven items from TTK), and Part E (20 items from TCLQ). A 10 point-interval scale was used, which includes "1 as Strongly Disagree" to "10 as Strongly Agree" for Parts B, C, D and E. The researchers distributed the questionnaire online. The research data was collected from 100 respondents, who all answered the questionnaire.

2.1. Data analysis

All the collected data were then analyzed using the statistical package for the social sciences (SPSS) software version 25. Descriptive and inferential statistics were used to achieve the research objectives. Parametric statistics were used in this study since all the data were normally distributed. The summary of descriptive and inferential statistics used in the study is shown in Table 1.

Table 1. Data analysis

Research objective	Data analysis
1. To identify the level of teachers' content knowledge, pedagogical knowledge, and technological knowledge, and cooperative learning implementation.	Descriptive statistics (frequency, percentage, mean, and standard deviation)
2. To determine any differences between years of teaching in the TSP, and the implementation of cooperative learning, content knowledge, pedagogical knowledge, and technological knowledge.	Inferential statistics (One Way ANOVA)
3. To identify the relationship between teachers' content knowledge, pedagogical knowledge, and technological knowledge with cooperative learning implementation.	Inferential statistics (Pearson Correlation)

A reliability test was conducted to obtain the internal consistency of the instrument. The researchers determined the internal consistency of the instruments via Cronbach's alpha value. Table 2 shows the Cronbach's alpha value results. A high value of Cronbach's alpha value was obtained for CK, PK, TK, and TCLQ, ranging from 0.961 to 0.980. This reflects that the items in the instruments were necessary for an internally reliable measure of the concept.

Table 2. Reliability test

Variable	Cronbach alpha (α)
Content knowledge (CK)	0.966
Pedagogical knowledge (PK)	0.967
Technological knowledge (TK)	0.961
Teachers' cooperative learning implementation (TCLQ)	0.980

3. RESULTS AND DISCUSSION

3.1. Respondents' demographics

Table 3 reports the demographic backgrounds of the respondents. In this study, we categorized the teachers into three generational age groups: under 26 (Gen Z; born 1997-2012), 26–41 (Gen Y; born 1996-1981) and over 42 (Gen X; born in 1980-1946). Two teachers from Gen Z, 52 teachers from Gen Y and 46 teachers from Gen X were involved. According to years of teaching experience in TSP, 20 teachers had less than four years of teaching experience in TSP, 22 teachers had 4–5 years of teaching experience, and 58 teachers had over five years of teaching experience.

Table 3. Respondent demographics

Variable	Category	Frequency (n)	Percentage (%)
Age	<26	2	54
	26-41	52	43
	>42	46	3
Years of teaching experience in TSP	0-3	20	20
	4-5	22	22
	>5	58	58

3.2. Respondents' level of content knowledge, pedagogical knowledge, technological knowledge, and cooperative learning implementation

Table 4 indicates that most respondents have a high level of content knowledge, pedagogical knowledge, technological knowledge, and implementation of cooperative learning. The results are 93%, 92%, 68%, and 92%, respectively. This finding proves that elementary TSP teachers master the core components of teachers' knowledge (content knowledge, pedagogical knowledge, technological knowledge). However, the teachers felt they had not yet fully mastered technological knowledge (M=7.52), thus this knowledge score was the lowest among content and pedagogical knowledge as in Table 4.

Table 4. Summary of descriptive analysis

Variable	Level	Frequency	Percentage (%)	Mean	SD
Content knowledge	Low				
	Moderate	7	7	8.49	.982
	High	93	93		
Pedagogical knowledge	Low				
	Moderate	8	8	8.46	.934
	High	92	92		
Technological knowledge	Low	1	1		
	Moderate	31	31	7.52	1.359
	High	68	68		
Teachers' cooperative learning implementation	Low				
	Moderate	8	8	8.30	.986
	High	92	92		

*1.00-4.00=low, 4.01-7.01=moderate, 7.02-10.00=high

3.3. Comparison of teachers' content knowledge, pedagogical knowledge, technological knowledge, and implementation of cooperative learning for differences in years of teaching experience using the ANOVA analysis

The years of one's experience have evolved into a crucial factor in every issue, including teachers' knowledge and teaching practice. The study found that experienced Trust School Program teachers (teaching experience>5 years) have the highest score on content knowledge (M=8.63), pedagogical knowledge (M=8.55), and implementation of cooperative learning (M=8.38). Conversely, novice TSP teachers score the highest for technological knowledge (M=7.89). Based on ANOVA analysis, there is no significant difference between teachers' cooperative learning implementation, content knowledge, pedagogical knowledge, and technological knowledge based on their years of teaching experience, see Table 5.

Table 5. ANOVA analysis

Variable	Year	N	Mean	F	p
Cooperative learning implementation	1-3	20	8.13		
	4-5	22	8.24	.533	.589
	>5	58	8.38		
Content knowledge	1-3	20	8.29		
	4-5	22	8.30	1.426	.245
	>5	58	8.63		
Pedagogical knowledge	1-3	20	8.25		
	4-5	22	8.42	.770	.466
	>5	58	8.55		
Technological knowledge	1-3	20	7.89		
	4-5	22	7.31	1.040	.357
	>5	58	7.48		

3.4. Relationship between teachers' content knowledge, pedagogical knowledge, technological knowledge, and cooperative learning implementation

The correlation analysis is reported in Table 6. The correlation findings showed that all independent variables were positively correlated with the dependent variable. The results indicate that the highest positive relationship was found between content knowledge and cooperative learning implementation, and, pedagogical knowledge and cooperative learning implementation, with *r* values between 0.551–0.603. Notably, a moderate positive relationship exists between technological knowledge and cooperative learning implementation, with an *r*-value of 0.384.

Table 6. Correlation analysis

Variable	1	2	3	4
Cooperative learning implementation	1.000			
Content knowledge	.551**	1.000		
Pedagogical knowledge	.603**	.813**	1.000	
Technological knowledge	.384**	.508**	.581**	1.000

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

Overall, teachers' content knowledge, pedagogical knowledge, technological knowledge, and cooperative learning implementation are at a high level. However, our study found that novice teachers score the highest for technological knowledge compared with experienced teachers. This finding contradicts a study [32], but is in line with the findings of previous studies [33], [34]. Additionally, the high level of technological knowledge also contributes from 54% of Gen Z and Gen Y teachers in our study. Gen Z teachers were born with digital technology, and Gen Y teachers grew up with the internet and digital technologies (born between 1981–1996) [40].

Although teachers had less than four years of teaching experience in trust school programs, their teachers' knowledge, and cooperative learning implementation were at a high level. This is in line with our finding that there is no significant difference between teachers' content knowledge, pedagogical knowledge, technological knowledge, and years of teaching experience. The result repudiates the previous finding [41], posited that there is a significant difference between the implementation of cooperative learning based on years of teaching experience. In their studies, teachers with more teaching experience are more likely to use traditional teaching approaches. Therefore, our finding proved that in situ CPD training involving trusted schoolteachers had a positive impact on teaching and learning practice. Additionally, the strategic goal of the TSP to enhance teaching and learning quality was achievable.

The correlational analysis reveals a positive and moderate relationship between teachers' technological knowledge and the implementation of cooperative learning. Although the level of technological knowledge of trusted schoolteachers in Selangor is at a high level, the technology integration in cooperative learning implementation is only moderately used. This is due to the lack of technological resources in schools and in line with the findings by past study [42] which stated that the lack of technological resources leads to difficulty in technology integration in teaching and learning. The relationship between teachers' pedagogical knowledge and content knowledge with the implementation of cooperative learning shows a high positive correlation. Thus, the results obtained are in agreement with prior studies stating that mastery of content knowledge [24] and pedagogical knowledge [28] has a positive impact on the implementation of a student-centered teaching approach. This finding is consistent with those by Melesse and Gulie [43], who stated that continuous professional development positively influenced the quality of teaching. On the other hand, the culture of CPD amongst TSP teachers had a positive impact on teachers' knowledge and their ability to use the student-centered teaching approach.

4. CONCLUSION

Our study proved that teachers' knowledge is important to implement cooperative learning in school culture. The school culture must provide adequate and continuous professional development so that novice teachers together with experienced teachers can implement cooperative learning routinely and successfully. The findings of this study can assist the MOE in the success of public-private partnerships through TSP. The findings could also help the teacher professionalism division, MOE, to identify teachers' needs in order to implement innovation in teaching. The MOE could enhance the infrastructure in the school, especially the technological infrastructure, so that teachers can fully utilize this in teaching and learning. The findings of this study, however, are limited to the information in the questionnaire used to collect the data. The findings can be generalized to the other populations that have similar characteristics to the study population. Further studies could explore the impact of the variables on cooperative learning implementation and the relationship of other variables, such as teachers' attitudes and motivation toward cooperative learning implementation.

REFERENCES

[1] R. E. Slavin, "Cooperative learning in elementary schools," *Education 3-13*, vol. 43, no. 1, pp. 5–14, Jan. 2015, doi: 10.1080/03004279.2015.963370.

[2] N. Abdul Rahim, N. A. Meor Fadzir, N. A. H. Zaimal, F. F. Arias Yahaya, Z. I. Zainol, and M. R. Husin, "Implications of Cooperative Learning Styles in Science Subjects for Stage Two Students at Sekolah Kebangsaan Bandar Baru Rawang," *Journal of Humanities and Social Sciences*, vol. 3, no. 2, pp. 57–66, Aug. 2021, doi: 10.36079/lamintang.jhass-0302.238.

[3] S. Kamaruddin and N. M. R. N. Yusoff, "The Effectiveness of Cooperative Learning Model Jigsaw and Team Games Tournament (TGT) towards Social Skills," *Creative Education*, vol. 10, no. 12, pp. 2529–2539, 2019, doi: 10.4236/ce.2019.1012180.

[4] W. S. Alaloul and A. H. Qureshi, "Cooperative problem-based learning experience and coaching strategies of engineering course," *International Journal of Evaluation and Research in Education (IJERE)*, vol. 11, no. 2, p. 848, Jun. 2022, doi: 10.11591/ijere.v11i2.22243.

[5] F. Razali, "Exploring Crucial Factors of an Interest in STEM Career Model among Secondary School Students," *International Journal of Instruction*, vol. 14, no. 2, pp. 385–404, Apr. 2021, doi: 10.29333/iji.2021.14222a.

[6] Ministry of Education Malaysia, "Malaysia Education Blueprint 2013-2025: Annual report 2018," 2018.

[7] A. Abramczyk and S. Jurkowski, "Cooperative learning as an evidence-based teaching strategy: what teachers know, believe, and how they use it," *Journal of Education for Teaching*, vol. 46, no. 3, pp. 296–308, May 2020, doi: 10.1080/02607476.2020.1733402.

[8] C. Buchs, D. Filippou, C. Pulfrey, and Y. Volpé, "Challenges for cooperative learning implementation: reports from elementary school teachers," *Journal of Education for Teaching*, vol. 43, no. 3, pp. 296–306, May 2017, doi: 10.1080/02607476.2017.1321673.

[9] A. F. Zulkifli and M. F. A. Adnan, "The Perception of Cooperative Learning in Teaching and Learning in Central Malaysia High School," *Social and Management Research Journal*, vol. 18, no. 1, p. 17, Feb. 2021, doi: 10.24191/smrj.v18i1.5783.

[10] A. Mukuka, V. Mutarutinya, and S. Balimuttajjo, "Exploring The barriers to effective cooperative learning implementation in school mathematics classrooms," *Problems of Education in the 21st Century*, vol. 77, no. 6, pp. 745–757, 2019, doi: 10.33225/pec/19.77.745.

[11] H. Ibrahim Yildirim and O. Sensoy, "Effect of Science Teaching Enriched with Technological Practices on Attitudes of Secondary School 7th Grade Students towards Science Course," *Universal Journal of Educational Research*, vol. 6, no. 5, pp. 947–959, May 2018, doi: 10.13189/ujer.2018.060516.

[12] OECD, *PISA 2021 ICT Framework*. OECD Publishing, 2019.

[13] F. Razali, T. Sulaiman, A. F. M. Ayub, and N. A. Majid, "Effects of Learning Accessibility as a Mediator between Learning Styles and Blended Learning in Higher Education Institutions during the Covid-19 Pandemic," *Asian Journal of University Education*, vol. 18, no. 2, pp. 569–584, Apr. 2022, doi: 10.24191/ajue.v18i2.18189.

[14] G. P. Adhikari, "Teachers' Perception and Challenges of Using ICT in Teaching Mathematics at Secondary Level," *Mathematics Education Forum Chitwan*, vol. 6, no. 6, pp. 50–65, Dec. 2021, doi: 10.3126/mefc.v6i6.42405.

[15] K. Regan, A. S. Evmenova, D. Sacco, J. Schwartzer, D. S. Chirinos, and M. D. Hughes, "Teacher perceptions of integrating technology in writing," *Technology, Pedagogy and Education*, vol. 28, no. 1, pp. 1–19, Jan. 2019, doi: 10.1080/1475939X.2018.1561507.

[16] G. Zhao, T. Long, R. Zhao, X. Yang, X. Zhang, and D. Hyerle, "How was teaching thinking adopted and diffused in Chinese primary schools? A qualitative study from principals' perspectives," *Asia Pacific Journal of Education*, vol. 43, no. 1, pp. 299–316, Jan. 2023, doi: 10.1080/02188791.2021.1911786.

[17] H. S. Low and F. Mydin Kutty, "Keberkesanan Think-Pair-Share Terhadap Motivasi dan Penglibatan Murid dalam Penguasaan Penulisan Bahasa Malaysia Sekolah SJK(C)," (in Malay), *Malaysian Journal of Social Sciences and Humanities (MJSSH)*, vol. 7, no. 5, p. e001517, May 2022, doi: 10.47405/mjssh.v7i5.1517.

[18] R. Osman, F. Md Jaafar, K. Saidin, and N. Abdan, "Kesan Pembelajaran Koperatif Dan Tradisional Terhadap Pencapaian Akademik Penguasaan Kemahiran Jawi," (in Malay), *Ulum Islamiyyah*, vol. 19, pp. 57–70, 2017, doi: 10.33102/uij.vol19no.47.

[19] M. Takko, R. Jamaluddin, S. A. Kadir, N. Ismail, A. Abdullah, and A. Khamis, "Enhancing Higher-Order Thinking Skills among Home Science Students: The Effect of Cooperative Learning Student Teams- Achievement Divisions (STAD) Module," *International Journal of Learning, Teaching and Educational Research*, vol. 19, no. 7, pp. 204–224, Jul. 2020, doi: 10.26803/ijlter.19.7.12.

[20] M. S. Nizam and M. S. Taat, "Pembelajaran Koperatif Kemahiran 4K dan Penggunaan Media Digital terhadap Sikap Akademik Pelajar," (in Malay), *Malaysian Journal of Social Sciences and Humanities (MJSSH)*, vol. 5, no. 4, pp. 133–141, Apr. 2020, doi: 10.47405/mjssh.v5i4.393.

[21] A. S. E. Hidayat and F. Setyawan, "Analysis of secondary school mathematics teachers' pedagogical content knowledge and intended teaching in curriculum reformation," *Journal of Physics: Conference Series*, vol. 1613, no. 1, 2020, doi: 10.1088/1742-6596/1613/1/012082.

[22] X. Yang, G. Kaiser, J. König, and S. Blömeke, "Relationship between pre-service mathematics teachers' knowledge, beliefs and instructional practices in China," *ZDM*, vol. 52, no. 2, pp. 281–294, May 2020, doi: 10.1007/s11858-020-01145-x.

[23] I. J. Bature, "The Mathematics Teachers Shift from the Traditional Teacher-Centred Classroom to a More Constructivist Student-Centred Epistemology," *OALib*, vol. 07, no. 05, pp. 1–26, 2020, doi: 10.4236/oalib.1106389.

[24] U. Uluçinar, "The Associations Between Learning-Teaching Conceptions and Technological Pedagogical Content Knowledge: A Structural Equation Modeling Study," *Psycho-Educational Research Reviews*, vol. 10, no. 2, pp. 58–76, Aug. 2021, doi: 10.52963/PERR_Biruni_V10.N2.04.

[25] M. Şen, C. Öztekin, and B. Demirdöğen, "Impact of Content Knowledge on Pedagogical Content Knowledge in the Context of Cell Division," *Journal of Science Teacher Education*, vol. 29, no. 2, pp. 102–127, Feb. 2018, doi: 10.1080/1046560X.2018.1425819.

[26] F. Kaya, L. A. Borgerding, and T. Ferdous, "Secondary Science Teachers' Self-Efficacy Beliefs and Implementation of Inquiry," *Journal of Science Teacher Education*, vol. 32, no. 1, pp. 107–121, Jan. 2021, doi: 10.1080/1046560X.2020.1807095.

[27] L. Meroño, A. Calderón, and J. L. Arias-Estero, "Digital pedagogy and cooperative learning: Effect on the technological pedagogical content knowledge and academic achievement of pre-service teachers," *Revista de Psicodidáctica (English ed.)*, vol. 26, no. 1, pp. 53–61, Jan. 2021, doi: 10.1016/j.psicoe.2020.10.002.

[28] B. Yu, W. C. Smith, and Y. Cao, "The relationship between propositional teacher knowledge and classroom teaching practice: the case of Chinese novice mathematics teachers," *Asia Pacific Journal of Education*, pp. 1–17, Jul. 2022, doi: 10.1080/02188791.2022.2096570.

[29] R. Abd Aziz, U. K. Abdul Manaf, A. F. M. Ayub, and N. binti Jafri, "The Relationship Between Teachers' Knowledge and The Implementation of Project Based Learning at Vocational College," *International Journal of Academic Research in Business and Social Sciences*, vol. 10, no. 6, Jun. 2020, doi: 10.6007/IJARBSS/v10-i6/7373.

[30] M. Schmid, E. Brianza, and D. Petko, "Developing a short assessment instrument for Technological Pedagogical Content Knowledge (TPACK.) and comparing the factor structure of an integrative and a transformative model," *Computers & Education*, vol. 157, p. 103967, Nov. 2020, doi: 10.1016/j.compedu.2020.103967.

[31] Y. Li, V. Garza, A. Keicher, and V. Popov, "Predicting High School Teacher Use of Technology: Pedagogical Beliefs, Technological Beliefs and Attitudes, and Teacher Training," *Technology, Knowledge and Learning*, vol. 24, no. 3, pp. 501–518, Sep. 2019, doi: 10.1007/s10758-018-9355-2.
[32] M. Ozudogru and F. Ozudogru, "Technological Pedagogical Content Knowledge of Mathematics Teachers and the Effect of Demographic Variables," *Contemporary Educational Technology*, vol. 10, no. 1, pp. 1–24, Jan. 2019, doi: 10.30935/cet.512515.
[33] W. Thinzarkyaw, "The Practice of Technological Pedagogical Content Knowledge of Teacher Educators in Education Colleges in Myanmar," *Contemporary Educational Technology*, vol. 11, no. 2, pp. 159–176, Dec. 2019, doi: 10.30935/cet.660829.
[34] F. S. Mohamad, "Technological Pedagogical Content Knowledge (TPACK) and the Teaching of Science: Determiners for Professional Development," *Studies of Applied Economics*, vol. 39, no. 1, Oct. 2021, doi: 10.25115/eea.v39i1.4272.
[35] P. Mishra and M. J. Koehler, "Technological Pedagogical Content Knowledge: A Framework for Teacher Knowledge," *Teachers College Record: The Voice of Scholarship in Education*, vol. 108, no. 6, p. 1017, 2006, doi: 10.1177/016146810610800610.
[36] M. Fullan, *The New Meaning of Educational Change*. Teachers College Press, 2015.
[37] S. Pamuk, M. Ergun, R. Cakir, H. B. Yilmaz, and C. Ayas, "Exploring relationships among TPACK components and development of the TPACK instrument," *Education and Information Technologies*, vol. 20, no. 2, pp. 241–263, 2015, doi: 10.1007/s10639-013-9278-4.
[38] D. A. Schmidt, E. Baran, A. D. Thompson, P. Mishra, M. J. Koehler, and T. S. Shin, "Technological Pedagogical Content Knowledge (TPACK)," *Journal of Research on Technology in Education*, vol. 42, no. 2, pp. 123–149, Dec. 2009, doi: 10.1080/15391523.2009.10782544.
[39] J. A. Prieto-Saborit, D. Méndez-Alonso, F. Ordóñez-Fernández, and J. R. Bahamonde, "Validation of a Cooperative Learning Measurement Questionnaire from a Teaching Perspective," *Psicothema*, vol. 34, no. 1, pp. 160–167, 2022, doi: 10.7334/psicothema2021.126.
[40] J. Philip and V. Kosmidou, "How proactive personality and ICT-enabled technostress creators configure as drivers of job crafting," *Journal of Management & Organization*, vol. 29, no. 4, pp. 724–744, Jul. 2023, doi: 10.1017/jmo.2022.56.
[41] J. A. P. Saborit, J. Fernández-Río, J. A. Cecchini Estrada, A. Méndez-Giménez, and D. M. Alonso, "Teachers' attitude and perception towards cooperative learning implementation: Influence of continuing training," *Teaching and Teacher Education*, vol. 59, pp. 438–445, Oct. 2016, doi: 10.1016/j.tate.2016.07.020.
[42] K. Kwon *et al.*, "Teachers' Self-efficacy Matters: Exploring the Integration of Mobile Computing Device in Middle Schools," *TechTrends*, vol. 63, no. 6, pp. 682–692, Nov. 2019, doi: 10.1007/s11528-019-00402-5.
[43] S. Melesse and K. Gulie, "The Implementation of Teachers' Continuous Professional Development and Its Impact on Educational Quality: Primary Schools in Fagita Lekoma Woreda, Awi Zone, Amhara Region, Ethiopia in Focus," *Research in Pedagogy*, vol. 9, no. 1, pp. 81–94, Jun. 2019, doi: 10.17810/2015.93.

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