MATHEMATICS TEACHERS' PERFORMANCE AND TECHNOLOGICAL, PEDAGOGICAL,

AND CONTENT KNOWLEDGE (TPACK): BASIS FOR DEVELOPMENT

OF ENHANCEMENT PROGRAM

A Thesis Presented to the Faculty of the Graduate School College of Education West Visayas State University

La Paz, Iloilo City

In Partial Fulfilment

of the Requirements for the Degree

Master of Arts in Education

(Mathematics)

by

Maria Jhovel L. Temelo

November 2023

APPROVAL SHEET

A Thesis for the Degree

Master of Arts in Education

(Mathematics)

by

Maria Jhovel L. Temelo

Approved by the Research Committee:

CHERYL LYN C. DELGADO, Ph.D., Chairperson

ELIZABETH A. MAGALLANES, Ph.D., Member

RENE F. NOQUERA, PhD., Outside Expert

DOLLY ROSE F. TEMELO, Ph.D., Adviser

RICKY M. MAGNO, Ph.D. Dean

November 2023

Temelo, Maria Jhovel L., "Mathematics Teachers Performance and Technological, Pedagogical and Content Knowledge (TPACK): Basis for Development of Enhancement Program." Unpublished Master's Thesis (Mathematics), College of Education – Graduate School, West Visayas State University, Iloilo City, November 2023

Abstract

This descriptive-correlational study aimed to determine the relationship between teachers' performance and technological pedagogical and content knowledge (TPACK) as the basis for the development of an enhancement program. Thirty-five (35) proficient mathematics teachers were selected through a total enumeration sampling method from nine (9) secondary schools and two (2) integrated schools in the Municipality of Tigbauan. An adapted TPACK questionnaire which underwent expert validation was the instrument used. Copies of COT-RPMS rating sheets were also retrieved as the basis for teachers' performance. The mean and the standard deviation were employed for the descriptive analysis of the study. The inferential statistical tool used was Pearson's Product Moment Correlation Coefficient Test set at .05 alpha level of significance. The classroom observation tool-result-based performance management system (COT-RPMS) performance of mathematics teachers was generally "outstanding". The technological, pedagogical, and content knowledge of mathematics teachers were generally "very satisfactory". There is no significant relationship between teachers' performance and TPACK and its components. A TPACK enhancement program for mathematics teachers was developed based on the result of the study. It was

concluded that the respondents have sufficient knowledge in each domain of technological, pedagogical, and content knowledge (TPACK) and are also competent in delivering their lessons as reflected in their performance. The enhancement program developed can be utilized to enhance mathematics teachers' TPACK. Therefore, Upgrading 21st Century Mathematics Teachers' Technological, Pedagogical, and Content Knowledge (TPACK) is recommended for implementation during the in-service training program for teachers. Furthermore, school administrators have the option to incorporate the TPACK enhancement program into their teacher training initiatives.

Iloilo City

TABLE OF CONTENTS

		Page
Title	Page	i
Appro	ovai Sheet	ii
Acknowledgment		iii
Abstract		vi
Table of Contents		ix
List of Figures		xii
List of Tables		xiii
List of Appendices		xv
Chapter		
1	INTRODUCTION TO THE STUDY	1
	Background of the Study	2
	Theoretical Framework of the Study	5
	Statement of the Problem	9
	Hypotheses of the Study	10
	Definition of Terms	10
	Delimitation of the Study	12
	Significance of the Study	13
2	REVIEW OF RELATED LITRATURE	15
	Classroom Observation Tool – Result-Based Performance Management System (COT-RPMS)	16

	Technology in DepEd Classrooms	21
	Pedagogy among Teachers	25
	Content Knowledge of Teachers	28
	Technological Pedagogical and Content Knowledge (TPACK)	32
	Summary	38
3	RESEARCH DESIGN AND METHODOLOGY	40
	Research Design	40
	Methodology	41
	Respondents of the Study	41
	Research Instruments	38
	Data Gathering Instruments	42
	Data Gathering Procedure	47
	Data Analysis Procedure	48
4	RESULTS AND DISCUSSIONS	50
	Descriptive Data Analysis	51
	Inferential Data Analysis	59
	Development of Enhancement Program	93
	Rationale of Enhancement Plan Design	94
5	SUMMARY, CONCLUSION, IMPLICATIONS, AND RECOMMENDATIONS	102
	Summary of the Problem, Method, and Findings	102
	Findings	104

	Conclusions	105
	Implications	106
	Recommendations	109
REF	ERENCES	112
APPENDICES		138

Iloilo City

LIST OF FIGURES

Figure		Page
1	Schematic Diagram of the Study	8
2	Schedule and Distribution of COIs across Quarters for Proficient Teachers for SY 2022-2023	10
3	The Components of TPACK Framework	34
4	COT-RPMS Rating Sheet	44
5	Data Collection Procedure	48

LIST OF TABLES

Table		Page
1	Distribution of Respondents	42
2	Teacher Performance Indicator	45
3	TPACK Scores Interpretation	46
4	Classroom Observation Tool – Result-Based Performance Management System (COT-RPMS) Performance of Mathematics Teachers	52
5	Technological, Pedagogical, and Content Knowledge of Mathematics Teachers	55
6	Correlation Result among Mathematics Teachers Classroom Observation Tool – Result-Based Performance Management System (COT-RPMS) and Technological Knowledge	60
7	Correlation Result among Mathematics Teachers Classroom Observation Tool – Result-Based Performance Management System (COT-RPMS) and Pedagogical Knowledge	64
8	Correlation Result among Mathematics Teachers Classroom Observation Tool – Result-Based Performance Management System (COT-RPMS) and Content Knowledge	69
9	Correlation Result among Mathematics Teachers Classroom Observation Tool – Result-Based Performance Management System (COT-RPMS) and Technological Pedagogical Knowledge	73
10	Correlation Result among Mathematics Teachers Classroom Observation Tool – Result-Based Performance Management System (COT-RPMS) and Pedagogical Content Knowledge	78
11	Correlation Result among Mathematics Teachers Classroom Observation Tool – Result-Based Performance Management System (COT-RPMS) and Technological Content Knowledge	83

12Correlation Result among Mathematics Teachers Classroom Observation
Tool – Result-Based Performance Management System (COT-RPMS)
and Technological Pedagogical Content Knowledge88

LIST OF APPENDICES

Appendix		Page
А	Letter to the Validators	139
В	Letter to the School Principals	146
С	Letter to the Iloilo Schools Division Office	158
D	Letter of Consent	160
Е	Standardized Classroom Observation Tool (Cot) Rating Sheet	162
F	Technological, Pedagogical, And Content Knowledge (TPACK) Questionnaire	164

113

References

21 Benefits of Technology in Education [You Didn't Know About]. (2022, December 20). 21 Benefits of Technology in Education [You Didn't Know About]. (2022, December 20). https://www.tryclarifi.com/benefits-of-technology-ineducation/#:~:text=What%20is%20Educational%20Technology%3F

- Abunda, N. D. (2020). Cross-sectional study on technological pedagogical content knowledge (tpack) of mathematics teachers. *Universal Journal of Educational Research, 8*(12A), 7651-7659. https://doi.org/10.13189/ujer.2020.082551
- Adnan, A., & Caca Yunisari. (2023). TPACK: Teachers' Needs. *Ta'dib, 26*(1), 143–143. https://doi.org/10.31958/jt.v26i1.9072
- Akram, H., Abdelrady, A. H., Al-Adwan, A. S., & Ramzan, M. (2022). Teachers' Perceptions of Technology Integration in Teaching-Learning Practices: A Systematic Review. *Frontiers in Psychology*, *13*. https://doi.org/10.3389/fpsyg.2022.920317
- Alqurashi, E., Gokbel, E. N., & Carbonara, D. (2016). Teachers' knowledge in content, pedagogy and technology integration: A comparative analysis between teachers in Saudi Arabia and United States. *British Journal of Educational Technology*, *48*(6), 1414–1426. https://doi.org/10.1111/bjet.12514
- Alsubaie, M. (2016). *Curriculum Development: Teacher Involvement in Curriculum Development*. https://files.eric.ed.gov/fulltext/EJ1095725.pdf

Andyani, H., Setyosari, P., Wiyono, B. B., & Djatmika, E. T. (2020). Does technological pedagogical content knowledge impact on the use of ict in pedagogy?. *International Journal of Emerging Technologies in Learning (IJET), 15*(03), 126. https://doi.org/10.3991/ijet.v15i03.11690

- Angeli, C., & Valanides, N. (Eds.). (2014). *Technological pedagogical content knowledge: Exploring, developing, and assessing TPCK.* Springer.
- Archambault, L., & Crippen, K. (2009). Examining TPACK Among K-12 Online Distance Educators in the United States. *Contemporary Issues in Technology and Teacher Education*, 9(1), 71–88. https://www.learntechlib.org/primary/p/29332
- Assessing the content knowledge needed for effective teaching. (2016.). Higher Ed Dive. https://www.highereddive.com/spons/assessing-the-content-knowledge-neededfor-effective-teaching/423547/
- Ball, Deborah & Thames, Mark & Phelps, Geoffrey. (2008). Content Knowledge for Teaching What Makes It Special?. *Journal of Teacher Education,59*.
 10.1177/0022487108324554.
- Barendsen, E. and Henze, I. (2017). Relating teacher pck and teacher practice using classroom observation. *Research in Science Education, 49*(5), 1141-1175. https://doi.org/10.1007/s11165-017-9637-z
- Barrogo, S. (2020). Teachers' Perception of Standardized Classroom Observation Tool. *International Journal of Academic Pedagogical Research (IJAPR)*, *4*, 33–37. https://files.eric.ed.gov/fulltext/ED606699.pdf

- Bauer, J.R., & Kenton, J.M. (2005). Toward Technology Integration in the Schools: Why It Isn't Happening. *The Journal of Technology and Teacher Education, 13*, 519-546.
- Cahapay, M. B. (2021). Technological pedagogical knowledge self-efficacy and continuance intention of philippine teachers in remote education amid covid-19 crisis. *Journal of Pedagogical Research*, *5*(3), 68-79. https://doi.org/10.33902/jpr.2021370614
- Calingasan, L. Y. (2018). Factors that Shape and Determine the Social Studies Curriculum in Philippine Basic Education (1980s–2010). *Asia Pacific Journal on Curriculum Studies*, 1–6. https://doi.org/10.53420/apjcs.2018.1
- Caratiquit, K., & Pablo, R. (2021). Exploring the practices of secondary school teachers in preparing for classroom observation amidst the new normal of education. *Journal of Social, Humanity, and Education, 1*(4), 281–296. https://doi.org/10.35912/jshe.v1i4.721
- Cash, A. H. (2016). A Call for Mixed Methods in Evaluating Teacher Preparation
 Programs. Handbook of Research on Professional Development for Quality
 Teaching and Learning. https://www.igi-global.com/chapter/a-call-for-mixed methods-in-evaluating-teacher-preparation-programs/156806

Cekerol, K., & Ozen, E. (2020). Evaluation Of Teachers' Technological Pedagogical Content Knowledge Within The Framework Of Educational Information Network And Other Variables. *Turkish Online Journal of Distance Education*, 61–78. https://doi.org/10.17718/tojde.770914

Chai, C. S., Koh, J. H. L., & Tsai, C. C. (2013). A review of technological pedagogical content knowledge. *Journal of Educational Technology & Society, 16*(2), 31-51.

Cup, E., Dissertations, & Boucaud, A. (2017). *DigitalCommons@CSP DigitalCommons@CSP A Correlational Study Examining the Relationship Between A Correlational Study Examining the Relationship Between Restorative Practices and School Climate in Selected Elementary Restorative Practices and School Climate in Selected Elementary Schools in a Large Mid-Atlantic Urban School District Schools in a Large Mid-Atlantic Urban School District*. https://core.ac.uk/download/pdf/327228538.pdf

Darling-Hammond, L., & Bransford, J. (2005). Preparing Teachers for a Changing World: What Teachers Should Learn and Be Able to Do. In *ERIC*. Jossey-Bass, An Imprint of Wiley. https://eric.ed.gov/?id=ED496378

Darling-Hammond, L. (2006). Constructing 21st-Century Teacher Education. *Journal of Teacher Education*, *57*(3), 300–314. https://doi.org/10.1177/0022487105285962

Darling-Hammond, L. (2017). Teacher education around the world: What can we learn from international practice? *European Journal of Teacher Education*, *40*(3), 291– 309. https://doi.org/10.1080/02619768.2017.1315399

Iloilo City

117

David, S. (2016). THE SIGNIFICANCE OF SOCIAL LEARNING THEORIES IN THE TEACHING OF SOCIAL STUDIES EDUCATION. International Journal of Sociology and Anthropology Research, 2(1), 40–45. https://www.eajournals.org/wpcontent/uploads/The-Significance-of-Social-Learning-Theories-in-the-Teachingof-Social-Studies-Education.pdf

DeCoito, I., & Richardson, T. (2018). Teachers and Technology: Present Practice and Future Directions. *Contemporary Issues in Technology and Teacher* Education, 18(2), 362–378. https://www.learntechlib.org/p/180395/

Dele, M., & Kolawole, O. (2015). Pedagogical knowledge and skill competences of preschool teachers in ibadan metropolis, JISTE, 19(2).

https://files.eric.ed.gov/fulltext/EJ1177147.pdf

DepEd highlights Digital Rise Program as key player in addressing challenges in

education guality | Department of Education. (n.d.).

https://www.deped.gov.ph/2022/05/10/deped-highlights-digital-rise-program-askey-player-in-addressing-challenges-in-education-guality/

DepEd (2018). DepEd Computerization Program (DCP) Handbook

DepEd Order 42, S. 2017

de Waal, E., & Grösser, M. M. (2009). Safety and security at school: A pedagogical perspective. Teaching and Teacher Education, 25(5), 697–706. https://doi.org/10.1016/j.tate.2008.12.002

Diallo, I. and Maizonniaux, C. (2016). Policies and pedagogies for students of diverse backgrounds. *International Journal of Pedagogies and Learning*, *11*(3), 201-210. https://doi.org/10.1080/22040552.2016.1279526

Drummond, A., & Sweeney, T. (2016). Can an objective measure of technological pedagogical content knowledge (TPACK) supplement existing TPACK measures? *British Journal of Educational Technology*, *48*(4), 928–939. https://doi.org/10.1111/bjet.12473

Education, 53(2), 106-116. https://doi.org/10.1177/0022487102053002003

Falloon, G. (2020). From digital literacy to digital competence: the teacher digital competency (TDC) framework. *Educational Technology Research and Development*, *68*(5). https://doi.org/10.1007/s11423-020-09767-4

FEBRUARY 3, 2023 DM 008, S. 2023 – Multi-Year Guidelines on the Results-Based Performance Management System-Philippine Professional Standards for Teachers / Department of Education. (n.d.). https://www.deped.gov.ph/2023/02/03/february-3-2023-dm-008-s-2023-multiyear-guidelines-on-the-results-based-performance-management-systemphilippine-professional-standards-for-teachers/

Francisco, R., & Caingcoy, M. (2022). Competencies of Basic Education Teachers and Performance of Learners in 2017-2018 National Achievement Test in the Philippines. Philarchive.org. https://philarchive.org/rec/FRACOB-3

Forbes, C. T., & Davis, E. A. (2010). Curriculum design for inquiry: Preservice elementary teachers' mobilization and adaptation of science curriculum materials. Journal of Research in Science Teaching, 47(7), 820–839. https://doi.org/10.1002/tea.20379

Gay, G. (2002). Preparing for culturally responsive teaching. Journal of Teacher

- Gong, X., Wei, B., Bergey, B. W., & Shockley, E. T. (2022). Unpacking Chemistry Teachers' Pedagogical Reasoning and Decisions for a PhET Simulation: A TPACK Perspective. Journal of Chemical Education. https://doi.org/10.1021/acs.jchemed.2c00397
- Guerriero, S. (2017). Teachers' Pedagogical Knowledge and the Teaching Profession Background Report and Project Objectives.

https://www.oecd.org/education/ceri/Background_document_to_Symposium_ITE L-FINAL.pdf

- Importance of Teachers' Pedagogical Knowledge. (n.d.). Www.linkedin.com. Retrieved April 24, 2023, from https://www.linkedin.com/pulse/importance-teacherspedagogical-knowledge-nina-smith-ed-d-
- Hafiz, N., Ahmed, Rizwan Pasha, A., & Malik, M. (2021). The Role of Teacher Training Programs in Optimizing Teacher Motivation and Professional Development Skills. Bulletin of Education and Research, 43(2), 17–37. https://files.eric.ed.gov/fulltext/EJ1338294.pdf

- Han, S., Cetin, C., & Matteson, S. M. (2016). Examining the pattern of middle grade mathematics teachers' performance: a concurrent embedded mixed methods study. *EURASIA Journal of Mathematics, Science and Technology Education, 12*(3). https://doi.org/10.12973/eurasia.2016.1206a
- Haron, M. Z., Zalli, M. M. M., Othman, M. K., & Awang, M. I. (2021). Examining the teachers' pedagogical knowledge and learning facilities towards teaching quality. *International Journal of Evaluation and Research in Education (IJERE)*, *10*(1), 1. https://doi.org/10.11591/ijere.v10i1.20780
- Harris, J., & Hofer, M. (n.d.). Journal of Research on Technology in Education | 211
 Technological Pedagogical Content Knowledge in Action: A Descriptive Study of
 Secondary Teachers' Curriculum-Based. *Technology-Related Instructional Planning JRTE |, 43*(3), 211–229. https://files.eric.ed.gov/fulltext/EJ918905.pdf
- Harris, J. and Hofer, M. (2011). Technological pedagogical content knowledge (tpack) in action. *Journal of Research on Technology in Education, 43*(3), 211-229. https://doi.org/10.1080/15391523.2011.10782570
- Hashim, A. (2015). Pedagogical content knowledge among the teachers of special classes of reading and memorizing the qur'an (kkq) in kuala lumpur. *Journal of Educational and Social Research.* https://doi.org/10.5901/jesr.2015.v5n1s1p175
- Hattie, J., & Timperley, H. (2007). The power of feedback. *Review of Educational Research*, *77*(1), 81–112. https://doi.org/10.3102/003465430298487

Iloilo City

Hattie, J. (2009). *Visible Learning*. https://apprendre.auf.org/wp-content/opera/13-BF-References-et-biblio-RPT-

2014/Visible%20Learning_A%20synthesis%20or%20over%20800%20Metaanalyses%20Relating%20to%20Achievement Hattie%20J%202009%20...pdf

- Hayati, N., Kadarohman, A., Sopandi, W., Martoprawiro, M. A., & Rochintaniawati, D.
 (2022). Chemistry Teachers' TPACK Competence: Teacher Perception and Lesson
 Plan Analysis. *Technium Social Sciences Journal*, *34*, 237–247.
 https://doi.org/10.47577/tssj.v34i1.7079
- Hew, K. F., & Brush, T. (2007). Integrating technology into K-12 teaching and learning: current knowledge gaps and recommendations for future research. *Educational Technology Research and Development*, *55*(3), 223–252. https://doi.org/10.1007/s11423-006-9022-5
- Hill, H. C., Rowan, B., & Ball, D. L. (2005). Effects of Teachers' Mathematical
 Knowledge for Teaching on Student Achievement. *American Educational Research Journal*, *42*(2), 371–406. https://doi.org/10.3102/00028312042002371
- Hill, H. C., Sleep, L., Lewis, J. M., & Ball, D. L. (2007). Assessing teachers' mathematical knowledge: What knowledge matters and what evidence counts?.
 In Mathematics teachers at work: Connecting curriculum materials and classroom instruction (pp. 111-132). Routledge.
- Indicio, Anicia R.; (2014). Teachers Development Needs for Instructional Competence Under the Results Based Performance management System,

122

Irdalisa, I. (2022). Technological pedagogical content knowledge: ability prospective teachers biology education department in jakarta indonesia. International *Journal* of Educational Research Review, 7(2), 114-123. https://doi.org/10.24331/ijere.1050594

Jackson, I., Gonzales, M. M., & Mensah, A. (2022). It is not equitable if it is not culturally sustaining: teaching and learning in 1:1 laptop schools. *Journal for Multicultural Education, 16*(4), 323-336. https://doi.org/10.1108/jme-09-2021-0180

K Agustini et al 2019 J. Phys.: Conf. Ser. 1387 012035

Kakeeto, D., Mugagga, A. M., & Bisaso, R. (2020). Curriculum Design and Teacher
Educators' Digital Competence: Promoting Learner-Centered Teaching Approach
in Higher Institutions of Learning. *Britain International of Linguistics Arts and Education (BIoLAE) Journal, 2*(3), 838.

https://www.academia.edu/60427428/Curriculum_Design_and_Teacher_Educato rs_Digital_Competence_Promoting_Learner_Centered_Teaching_Approach_in_Hi gher_Institutions_of_Learning

Keller, M. M., Neumann, K., & Fischer, H. E. (2016). The impact of physics teachers' pedagogical content knowledge and motivation on students' achievement and interest. *Journal of Research in Science Teaching*, *54*(5), 586–614. https://doi.org/10.1002/tea.21378

Khine, M. S., Ali, N., & Afari, E. (2016). Exploring relationships among TPACK constructs and ICT achievement among trainee teachers. *Education and Information Technologies*, *22*(4), 1605–1621. https://doi.org/10.1007/s10639-016-9507-8

- Knowing What We Teach and Teaching What We Know National Council of Teachers of Mathematics. (n.d.). Www.nctm.org. https://www.nctm.org/News-and-Calendar/Messages-from-the-President/Archive/Glenda-Lappan/Knowing-What-We-Teach-and-Teaching-What-We-Know
- Koehler, M. J., & Mishra, P. (2009). What is technological pedagogical content knowledge? *Contemporary Issues in Technology and Teacher Education*, 9(1), 60-70.
- Koehler, M. J., Mishra, P., & Cain, W. (2013). What is technological pedagogical content knowledge (tpack)?. *Journal of Education*, *193*(3), 13-19. https://doi.org/10.1177/002205741319300303

Koh, J. H. L., Chai, C. S., & Tsai, C. (2010). Examining the technological pedagogical content knowledge of singapore pre-service teachers with a large-scale survey. *Journal of Computer Assisted Learning, 26*(6), 563-573. https://doi.org/10.1111/j.1365-2729.2010.00372.x

Iloilo City

- Kontkanen, S., Dillon, P., Valtonen, T., Renkola, S., Vesisenaho, M., & Väisänen, P.
 (2014). Pre-service teachers' experiences of ict in daily life and in educational contexts and their proto-technological pedagogical knowledge. *Education and Information Technologies*, *21*(4), 919-943. https://doi.org/10.1007/s10639-014-9361-5
- Kurniawati, N., Maolida, E. H., & Anjaniputra, A. G. (2018). The praxis of digital literacy in the EFL classroom: Digital-immigrant vs digital-native teacher. *Indonesian Journal of Applied Linguistics, 8*(1). https://doi.org/10.17509/ijal.v8i1.11459
- Levy, L. A. (2018). 7 reasons why digital literacy is important for teachers. Online Graduate Education Programs | USC Rossier.

https://rossieronline.usc.edu/blog/teacher-digital-literacy/

- Ling, T., Kadir, S., & Abdullah, A. (2022). Professional community learning practice and self-regulation learning as a predictive factor in the technological pedagogical content knowledge among teachers of accounting principles. *International Journal of Academic Research in Progressive Education and Development, 11*(2). https://doi.org/10.6007/ijarped/v11-i2/13999
- Liu, F., Ritzhaupt, A. D., Dawson, K., & Barron, A. E. (2016). Explaining technology integration in K-12 classrooms: a multilevel path analysis model. *Educational Technology Research and Development*, *65*(4), 795–813. https://doi.org/10.1007/s11423-016-9487-9

- Liu, Q., Zhang, S., & Wang, Q. (2015). Surveying chinese in-service k12 teachers' technology, pedagogy, and content knowledge. *Journal of Educational Computing Research, 53*(1), 55-74. https://doi.org/10.1177/0735633115585929
- Liu, D. (2022). The factors of enhancing graduate teaching assistants' technological pedagogical content knowledge (tpack) performance in engineering curriculum teaching. *Discover Education, 1*(1). https://doi.org/10.1007/s44217-022-00017-8
- Llego, M. (2018, April 13). *Philippine Professional Standards for Teachers (PPST)* -*TeacherPH*. TeacherPH. https://www.teacherph.com/philippine-professionalstandards-for-teachers/
- Luzon, B. M. and Cubillas, T. E. (2022). Technological, pedagogical, and content knowledge of intermediate grade teachers in public schools: influence on work and academic performance. *International Journal of Scientific and Research Publications (IJSRP), 12*(1), 293-299.

https://doi.org/10.29322/ijsrp.12.01.2022.p12138

Mahler, D., Großschedl, J., & Harms, U. (2017). Using doubly latent multilevel analysis to elucidate relationships between science teachers' professional knowledge and students' performance. *International Journal of Science Education, 39*(2), 213-237. https://doi.org/10.1080/09500693.2016.1276641

- Mallik, A., Rahman, S. M. M., Rajguru, S. B., & Kapila, V. Fundamental: examining the variations in the tpack framework for teaching robotics-aided stem lessons of varying difficulty. 2018 ASEE Annual Conference & Amp; Exposition Proceedings. https://doi.org/10.18260/1-2--30550
- Mathematics Teacher Job Description, Career as a Mathematics Teacher, Salary, Employment - Definition and Nature of the Work, Education and Training Requirements, Getting the Job. (n.d.). Careers.stateuniversity.com. Retrieved November 6, 2023, from

https://careers.stateuniversity.com/pages/7863/Mathematics-Teacher.html

- Marlina, N. (2021). The effect of teacher's pedagogical content knowledge on learning outcomes with quality mediator student learning process (a perceptional study of grade xi students at sman in tasikmalya city).. https://doi.org/10.4108/eai.12-12-2020.2304978
- Mayol, P. A. (2022, October 13). *The Impact of Technology on Education in the Philippines*. CebuFinest. https://cebufinest.com/the-impact-of-technology-oneducation-in-the-philippines/
- McCoy, K., & Mathur, S. (2017). Differentiation in the Digital-Based Classroom: A Universal Design Approach for Inclusive Settings in Middle Schools. *Journal of Education and Development*, *1*(1), 1. https://doi.org/10.20849/jed.v1i1.219

McGraw Hill. (2019, April 16). What Is TPACK Theory and How Can It Be Used in the

Classroom? / McGraw-Hill Canada. Mheducation.ca.

https://www.mheducation.ca/blog/what-is-tpack-theory-and-how-can-it-be-usedin-the-classroom/

McLeod, S. (2011). Albert Bandura's social learning theory.

Mcleod, S. (2023). Albert Bandura's Social Learning Theory. *Www.simplypsychology.org*. https://simplypsychology.org/bandura.html

Milner, H. R. (2013). But Subject Matter Content Knowledge Is Not Enough. *Urban Education, 48*(3), 347–349. https://doi.org/10.1177/0042085913485176

- Mishra, P. and Koehler, M. J. (2006). Technological pedagogical content knowledge:
 a framework for teacher knowledge. *Teachers College Record: The Voice of Scholarship in Education, 108*(6), 1017-1054. https://doi.org/10.1111/j.1467-9620.2006.00684.x
- M. Luzon, B., & E. Cubillas, T. (2022). Technological, Pedagogical, and Content Knowledge of Intermediate Grade Teachers in Public Schools: Influence on Work and Academic Performance. *International Journal of Scientific and Research Publications (IJSRP)*, *12*(1), 293–299.

https://doi.org/10.29322/ijsrp.12.01.2022.p12138

Mosia, M. and Matabane, M. E. (2022). Exploring factors that serve as predictors for mathematics and sciences pre-service teachers to use ict in teaching. *Research in Educational Policy and Management, 4*(1), 80-91. https://doi.org/10.46303/repam.2022.10

Muhaimin, M., Habibi, A., Mukminin, A., Saudagar, F., Pratama, R., Wahyuni, S., Sadikin,
A., & Indrayana, B. (2019). A sequential explanatory investigation of TPACK:
Indonesian science teachers' survey and perspective. *Journal of Technology and Science Education*, *9*(3), 269. https://doi.org/10.3926/jotse.662

- Navarro, C. M., Balba, M. J., Kim, J. I., & Garcia, J. A. (2021). Exploring Filipino Senior High School Teachers' TPACK in Emergency Remote Teaching. *Easychair.org*. https://easychair.org/publications/preprint/F6K9
- Nelson, J., Christopher, A., & Mims, C. (2009). TPACK and Web 2.0: Transformation of teaching and learning. *TechTrends*, 53(5), 88-92. doi:10.1007/s11528-009-0330-6
- Niess, M. L., Ronau, R. N., Shafer, K. G., Driskell, S. O., Harper, S. R., Johnston, C.,
 Browning, C., Özgün-Koca, S. A., & Kersaint, G. (2009). Mathematics teacher
 TPACK standards and development model. *Contemporary Issues in Technology & Teacher Education, 9*(1), 4–24.
- Niess, M. L. (2011). Investigating tpack: knowledge growth in teaching with technology. *Journal of Educational Computing Research*, 44(3), 299-317. https://doi.org/10.2190/ec.44.3.c

Odumosu, M., & Areelu. (2018). Teachers' content and pedagogical knowledge on students' achievement in algebra. *International Journal of Education and Research*, *6*(3).

Ogbonnaya, U. I. and Mogari, D. (2014). The relationship between grade 11 students' achievement in trigonometric functions and their teachers' content knowledge. M*editerranean Journal of Social Sciences*. https://doi.org/10.5901/mjss.2014.v5n4p443

Padillo, Gengen, et al. Professional development activities and teacher performance keywords classroom management knowledge of subject matter instructional development instructional planning professional development activities quality teaching teaching competencies. 2021, www.conscientiabeam.com/pdffiles/art/61/IJEP20219(3)497-506.pdf,

https://doi.org/10.18488/journal.61.2021.93.497.506.

Paidi, P., Hapsari, N., Subali, B., & Astuti, F. E. C. (2020). Teaching performance of high school biology teachers in applying tpack: A descriptive study. Proceedings of the International Conference on Educational Research and Innovation (ICERI 2019). https://doi.org/10.2991/assehr.k.200204.018

Pearl Villalon Tomaro, Q. (2018). ICT integration in the educational system of Philippines. *Journal of Governance and Public Policy*, 5(3). https://doi.org/10.18196/jgpp.5399

130

Possi, M., & Reginard Milinga, J. (2017). Learner Diversity in Inclusive Classrooms: The Interplay of Language of Instruction, Gender and Disability. *Malaysian Online Journal of Educational Sciences*. https://files.eric.ed.gov/fulltext/EJ1150435.pdf

Program Enhancement Plan Process. (n.d.).

https://www.ivcc.edu/academicaffairs/Program_Enhancement_Plan_Process.

- Pusparini, F., Riandi, R., & Sriyati, S. (2017). Developing technological pedagogical content knowledge (tpack) in animal physiology. *Journal of Physics: Conference Series, 895*, 012052. https://doi.org/10.1088/1742-6596/895/1/012052
- Putra, M. J. A., Widodo, A., & Sopandi, W. (2018, February 1). Content Representation on Earth and Space Topic by Experienced and Prospective Primary Teachers. Www.atlantis-Press.com; Atlantis Press. https://doi.org/10.2991/ice-17.2018.64
- Ramirez, Kristoffer Paulo. (2019). Technological, Pedagogical and Content Knowledge of Math Teachers of SMNHS.

Ramos, R. A., Babasa, E. E., Vergara, I. B., Manalo, B. I., Gappi, L. L., & Morfi, T. G. (2020). The TPACK confidence of pre-service teachers in selected philippine teacher education institutions. *International Journal of Education, Psychology and Counseling*, *5*(37), 196–205. https://doi.org/10.35631/ijepc.5370016

Reigeluth, C. M. (Ed.). (1999). *Instructional-design theories and models: A new* paradigm of instructional theory, 2. Lawrence Erlbaum Associates Publishers.

Relator, J. (2022). Technological Pedagogical and Content Knowledge (TPACK) Of Teachers in Relation to the Context and Their Teaching Performance, Loon, Bohol. ACADEME University of Bohol, Graduate School and Professional Studies, 20(1), 13–38. https://doi.org/10.15631/aubgsps.v20i1.177
Research Center for Teacher Quality (RCTQ) – The official website of the Philippine

- National Research Center for Teacher Quality (RCTQ) The Oncial Website of the Philippine National Research Center for Teacher Quality (RCTQ), a partnership by the Philippine Normal University and the University of New England-Australia. (n.d.). https://www.rctq.ph/
- Reynolds, W. M. and Park, S. (2020). Examining the relationship between the educative teacher performance assessment and preservice teachers' pedagogical content knowledge. *Journal of Research in Science Teaching, 58*(5), 721-748. https://doi.org/10.1002/tea.21676
- Roa, R. O. (2021). Technology Integration in the Classroom of Sta. Lucia Junior High School.
- Rochintaniawati, D., Riandi, R., Kestianty, J., Kindy, N., & Rukayadi, Y. (2019). The analysis of biology teachers' technological pedagogical content knowledge development in lesson study in west java indonesia. *Jurnal Pendidikan IPA Indonesia, 8*(2). https://doi.org/10.15294/jpii.v8i2.19303

Ruedas, A. J. (2019). The Teaching of Junior and Senior High School Mathematics in the Division of Quezon: Basis for In-Service Training. *Ascendens Asia Journal of Multidisciplinary Research Abstracts*, *3*(2L).

https://ojs.aaresearchindex.com/index.php/AAJMRA/article/view/11384

- Saboowala, R., & Manghirmalani Mishra, P. (2021). Readiness of In-service Teachers Toward a Blended Learning Approach as a Learning Pedagogy in the Post-COVID-19 Era. *Journal of Educational Technology Systems*, *50*(1), 004723952110152. https://doi.org/10.1177/00472395211015232
- Safder, M., Akhtar, M. M. S., Ghulam, F., & Malik, M. (2012). Problems faced by students with hearing impairment in inclusive education at the university level. *Journal of Research and Reflections in Education, 6*(2), 129-136. Retrieved from http://www.ue.edu.pk/journal.asp.
- Safriana, A., et al. (2023). Integrating technology into classroom learning: The role of TPACK in teacher pedagogical and professional ability indicators. *Journal of Education Technology, 45*(2), 211-225.
- Sahin, I. (2011). Development of Survey of Technological Pedagogical and Content Knowledge (TPACK). *Turkish Online Journal of Educational Technology* -*TOJET*, *10*(1), 97–105. https://eric.ed.gov/?id=EJ926558

Schmidt, D., Baran, E., Thompson, A., Mishra, P., Koehler, M., & Shin, T. (2009).

Technological Pedagogical Content Knowledge (TPACK): The Development and Validation of an Assessment Instrument for Preservice Teachers. *JRTE*, *42*(2), 123–149. https://files.eric.ed.gov/fulltext/EJ868626.pdf

School of Education. (2020, June 25). *How Important Is Technology in Education? Benefits, Challenges, and Impact on Students*. Soeonline.american.edu. https://soeonline.american.edu/blog/technology-in-education/

Serin, G. (2015). Alternative assessment practices of a classroom teacher: alignment with reform-based science curriculum. *EURASIA Journal of Mathematics, Science and Technology Education, 11*(2). https://doi.org/10.12973/eurasia.2015.1330a

- Sintema, E. J., & Jita, T. (2022). Pre-service teachers' self-concept and views toward using ICT for teaching science. *Eurasia Journal of Mathematics, Science and Technology Education, 18*(9), em2154. https://doi.org/10.29333/ejmste/12396
- Smeda, N., Dakich, E., & Sharda, N. (2014). The effectiveness of digital storytelling in the classrooms: a comprehensive study. *Smart Learning Environments*, 1(1). https://doi.org/10.1186/s40561-014-0006-3

Tabanao, S. M., Sucnaan, G., Clamocha, G., & Diquito, T. J. A. (2023). A phenomenological research study of classroom managers technological pedagogical content knowledge in emergency remote learning. *British Journal of Multidisciplinary and Advanced Studies, 4*(2), 42-51.
https://doi.org/10.37745/bjmas.2022.0132

Tachie, S. A. (2020, June 23). Improving teachers' pedagogical knowledge of teaching mathematics: Meta-cognitive skills and strategies application. Www.learntechlib.org; Association for the Advancement of Computing in Education (AACE). https://www.learntechlib.org/primary/p/217334/ Tapanan, H., Antig, M., & Tapanan, M. (2021). Assessment of Teachers' Performance and the Spiral Progression Approach in Mathematics. International Journal of Innovative Science and Research Technology, 6(1). https://ijisrt.com/assets/upload/files/IJISRT21JAN493.pdf The Results-based Performance Management System (RPMS) Manual for Teachers and School Heads was developed through the Philippine National Research Center for Teacher Quality (RCTQ) with support from the Australian Government through the Basic Education Sector Transformation (BEST) Program. © Department of Education -Bureau of Human Resource and Organizational Development Results-Based Performance Management System MANUAL for Teachers and School Heads Your quide to using RPMS Tools for Teachers from Portfolio preparation to assessment. (n.d.). http://depedcapiz.ph/downloads/RPMS_Manual.pdf

Tröbst, S., Kleickmann, T., Depaepe, F., Heinze, A., & Kunter, M. (2019). Effects of instruction on pedagogical content knowledge about fractions in sixth-grade mathematics on content knowledge and pedagogical knowledge.
Unterrichtswissenschaft, 47(1), 79-97. https://doi.org/10.1007/s42010-019-00041-y

135

- Tsafe, K. A. (2013). Teacher Pedagogical Knowledge in Mathematics: a tool for addressing learning problems. *Scientific Journal of Pure and Applied Sciences*. https://www.academia.edu/3271054/Teacher_Pedagogical_Knowledge_in_Mathe matics_a_tool_for_addressing_learning_problems
- Tseng., J. (2014). Investigating efl teachers' technological pedagogical content knowledge: students' perceptions. CALL Design: Principles and Practice -Proceedings of the 2014 EUROCALL Conference, Groningen, the Netherlands. https://doi.org/10.14705/rpnet.2014.000249
- Tyarakanita, A., Nurkamto, J., & Drajati, N. A. (2021). The indonesian efi teachers' tpack development in the online community of practice. *Pedagogy : Journal of English Language Teaching*, *9*(2), 121. https://doi.org/10.32332/joelt.v9i2.3229
- Ulucinar, U. (2021). The associations between learning-teaching conceptions and technological pedagogical content knowledge: a structural equation modeling study. *Psycho-Educational Research Reviews, 10*(2), 58-76. https://doi.org/10.52963/perr biruni v10.n2.04
- van Middelkoop, D., Ballafkih, H., & Meerman, M. (2017). Understanding diversity: a Dutch case study on teachers' attitudes towards their diverse student population. *Empirical Research in Vocational Education and Training*, *9*(1). https://doi.org/10.1186/s40461-016-0045-9

Iloilo City

Vergonia, B. and Mombas, S. E. (2022). Ready to go? profiling philippines high school teachers' readiness for blended learning in post-covid-19 era. Journal of Educational Management and Instruction (JEMIN), 2(1), 12-23. https://doi.org/10.22515/jemin.v2i1.4961

Voogt, J., Fisser, P., Roblin, N. P., Tondeur, J., & Braak, J. v. (2012). Technological pedagogical content knowledge - a review of the literature. Journal of Computer Assisted Learning, 29(2), 109-121. https://doi.org/10.1111/j.1365-2729.2012.00487.

- Wen, H. (2019). Assessing technological pedagogical and content knowledge (tpack): using teacher candidate reflections to examine tpack development. Proceedings of the 2019 AERA Annual Meeting. https://doi.org/10.3102/1440556
- What is Pedagogical Knowledge and Does it Matter? (2018, January 4). Montrose42 Blog; Montrose42 Blog.https://montrose42.wordpress.com/2018/01/04/what-ispedagogical-knowledge-and-does-it-matter/
- Wu, Y. T., Chai, C. S., & Wang, L. (2022). Exploring secondary school teachers' tpack for video-based flipped learning: the role of pedagogical beliefs. Education and Information Technologies, 27(6), 8793-8819. https://doi.org/10.1007/s10639-022-10977-x

Iloilo City

 Yildiz, N. O., Gungor, N. B., Kacay, Z., & Soyer, F. (2021). The Effect of Physical Education and Sports Teachers' Web-Technological Pedagogy Content Knowledge on Online Learning Readiness. *Pakistan Journal of Medical and Health Sciences, 15*(10), 3262–3268. https://doi.org/10.53350/pjmhs2115103262

- Yu, P. W. D., & Golden, J. (2019). *Developing TPACK in Elementary Mathematics Education: A Framework to Design Activities With Pre-Service Teachers*. Handbook of Research on TPACK in the Digital Age. https://www.igiglobal.com/chapter/developing-tpack-in-elementary-mathematicseducation/215495
- Zeng, Y. (2022). Analysing Teacher Knowledge for Technology Use among Secondary Teachers Teaching Chinese as a Foreign Language (CFL) in Australia. *Journal of Curriculum and Teaching*, *11*(2), 15. https://doi.org/10.5430/jct.v11n2p15
- Zhang, S., Liu, Q., & Cai, Z. (2019). Exploring primary school teachers' technological pedagogical content knowledge (tpack) in online collaborative discourse: an epistemic network analysis. *British Journal of Educational Technology*, *50*(6), 3437-3455. https://doi.org/10.1111/bjet.12751