International Journal of Innovative Research and Scientific Studies, 8(3) 2025, pages: 1573-1579

IJIRSS
International Journal of Innovative Research & Scientific Studies

ISSN: 2617-6548

URL: www.ijirss.com

Enhancing mathematics preservice teachers' learning achievement and research instrument development skills using a learning activity package

Apantee Poonputta

Mahasarakham University, Thailand.

(*Email: oomsin.putta@gmail.com*)

Abstract

The purposes of the study aimed to investigate the effects of a learning activity package on mathematics preservice teachers' learning achievement in research on mathematics teaching and their research instrument development skills. Utilizing a one-group pretest-posttest design, the sample included 25 third-year mathematics major students selected through random group sampling. The instruments used were a set of learning activity packages, a learning achievement test (multiple-choice), and a research instrument development skills form (rubric scoring). Data were analyzed using dependent samples t-test and one-sample t-test with a predetermined criterion of 75%. Results indicate significant improvements in pretest-posttest learning achievement and research instrument development skills, corroborating previous findings on learning activity package efficacy in teacher education.

Keywords: Learning Activity Package (LAP), Preservice Teachers, Research Instrument Development Skills, Skills.

DOI: 10.53894/ijirss.v8i3.6838
Funding: This research project was financially supported by Faculty of Education Mahasarakham University. (Grant Number: 67A002/2567).
History: Received: 14 March 2025 / **Revised:** 16 April 2025 / **Accepted:** 21 April 2025 / **Published:** 7 May 2025

Competing Interests: The author declares that there are no conflicts of interests regarding the publication of this paper.
Transparency: The author confirms that the manuscript is an honest, accurate, and transparent account of the study; that no vital features of the study have been omitted; and that any discrepancies from the study as planned have been explained. This study followed all ethical practices during writing.
Institutional Review Board Statement: The Ethical Committee of the Mahasarakham University, Thailand granted approval for this study. (Ref. No. 023-618-2567).
Publisher: Innovative Research Publishing

1. Introduction

Teacher education is crucial in determining the quality of the educational system, and therefore has a significant impact on the progress of a nation [1-3]. The presence of highly skilled educators is essential not only for their personal and professional growth but also for the evolution of the educational system and overall societal development [4, 5]. The significance of strong teacher education programs cannot be exaggerated, as they establish the foundation for a secure and forward-thinking educational setting [6].

Moreover, proficiency in study design is a crucial requirement for teachers. These skills are beneficial for the professional development of teachers as they enhance their ability to make important contributions to educational research and policy

design [7]. In addition, having research skills enables instructors to use evidence-based approaches in their classrooms, hence enhancing the quality of teaching [8-10]. Research-intensive universities have shown that empirical evidence from educational research can significantly enhance teaching and learning practices, leading to better student outcomes.

In order to cultivate these talents proficiently, educators must possess a thorough understanding of teaching techniques that are appropriate for their specific circumstances, evaluation instruments, and the process of creating behavior assessment tools. Moreover, they should possess the ability to integrate these components into their research pursuits effortlessly. In order to acquire these skills, individuals must engage in activities that promote stimulation and active involvement and foster collaboration. Traditional methods of listening and teaching often fall short of fostering the development of these abilities. Participating in practical tasks and cooperative endeavors fosters the development of analytical reasoning and active engagement, both of which are crucial for cultivating advanced abilities such as study design [11]. Through an analysis of students' requirements, it was determined that the practical aspect of teaching research courses is necessary so that students have the skills to conduct research [12].

Teacher education must include research design skills. Equipping student teachers with research methodology knowledge helps them systematically design their future teaching [7, 8, 11]. When teachers understand how to conduct research, it improves their teaching and helps them think systematically [13]. This understanding allows teachers to plan, execute, and evaluate their teaching strategies effectively, ensuring that their instructional methods are evidence-based and tailored to meet the diverse needs of their students. In addition, influential teacher researchers need to develop a wide range of instructional approaches. Understanding how different instructional methods work and their theories helps teachers select the most appropriate teaching methods and styles for their students [14]. This knowledge enables teachers to create a more engaging and effective learning environment by adapting their teaching strategies better to suit their students' learning styles and needs.

In addition, in educational research, knowing how assessment tools such as tests and questionnaires work is crucial [15]. This understanding helps teachers apply valid and reliable assessment methods that accurately reflect students' behaviors and learning outcomes. Mastering the development and implementation of these assessment tools allows teachers to gather meaningful data that informs their instructional decisions and enhances student learning [16]. For example, understanding test difficulty, discrimination, and reliability is essential. Test difficulty evaluates the challenge level of an assessment for students, ensuring that tests are properly calibrated to reliably gauge student knowledge without being too easy or unduly difficult. Test discrimination denotes an assessment's capacity to differentiate between students who have mastered the topic and those who have not, enabling educators to ascertain whether questions effectively separate varying degrees of student comprehension. Reliability pertains to the uniformity of assessment outcomes over time, guaranteeing that tests yield steady and consistent results across various administrations. Trustworthy evaluations yield reliable data, allowing educators to make educated instructional choices based on precise and consistent student performance metrics. The significance of cultivating skills in educational research instruments has resulted in their incorporation into teacher education programs. Curriculum designers acknowledge the necessity for preservice teachers to master research methodologies, which is why these competencies are integrated into teacher education programs. In Thailand, the focus of this study, research skills are integrated into teacher education via a mandatory research technique course for all preservice teachers [17]. Furthermore, preservice teachers must undertake a research project during their school internship. This integration guarantees that prospective educators are adequately equipped to perform research, implement research outcomes in their instruction, and enhance educational methodologies.

2. Literature Review

The Learning Activity Package (LAP) presents a possible alternative to conventional teaching approaches by redirecting attention from the passive acquisition of knowledge to active involvement and participation. This technique is an instructional tool or a collection of materials specifically created to facilitate students' self-directed learning experiences [18-20]. LAP often consists of a sequence of activities, materials, and evaluations designed to target specific educational goals. These educational materials are designed to encourage active learning among students, fostering exploration, critical thinking, and cooperation with their classmates [19, 20]. The Learning Activity Package (LAP) enhances the development of achievement, collaboration, research design skills, critical thinking, and problem-solving skills by incorporating stimulation, engagement, and collaboration elements. This would encourage students to promote integrating theoretical knowledge with practical application, enhancing preservice teachers' research capabilities and self-assurance. Setting.

Scholars have extensively studied the effects of learning activity packages (LAP) on teacher education and development. Overall, previous research indicates significant benefits of LAP as an instructional method, leading to developing various teaching-related skills. For instance, Agyei and Voogt [21] highlight LAP's role in enhancing teachers' ability to handle classroom activities effectively. Anwer [22] and Çakmak [23] found that LAP positively impacts academic achievement, while Pulido Gil et al. [24], Agwu Udu et al. [25], and Disathaporn et al. [26] noted improvements in students' thinking skills. Additionally, Anwer [22] and Dar [27] found that LAP influences teachers' beliefs and attitudes toward teaching, as evidenced.

Despite these positive findings, gaps in the literature warrant further exploration. Previous studies call for additional research into other areas of teachers' skills and the effects of LAP in different educational contexts. Recognizing the potential of LAP in developing preservice teachers' research design skills, this study aims to fill these gaps by creating a learning activity package to enhance preservice teachers' knowledge of instructional approaches and research tool development in Thailand. This approach seeks to build on the existing literature by demonstrating how LAP can improve preservice teachers' research skills, contributing to their overall professional development. The purposes of the study were to investigate the

effects of learning activity packages on mathematics preservice teachers' learning achievement in research in mathematics teaching and to investigate the effects of learning activity packages on mathematics preservice teachers' development of educational research instrument skills.

The current study devised a Learning Activity Package (LAP) to improve the research design abilities of mathematics preservice teachers. This method focuses on implementing novel instructional strategies in mathematics and developing instruments for conducting research. The study's results are anticipated to contribute substantially to teacher education by showcasing the influence of LAP on the learning experiences of pre-service teachers in the Thai setting.

3. Methodology

3.1. Participants

The participants were 25 pre-service teachers who were enrolled in the second semester of the 2023 academic year in the course called "Research in Mathematics Learning" at a public university in Thailand. The participants were selected using a cluster random sampling method to ensure a representative sample. The participants were treated with consideration for the ethical issues in human research.

3.2. Instruments

3.2.1. Learning Activity Package

The activities in the current study were designed using the principles of the learning activity package. Therefore, they focus on facilitating participants to develop their research skills through active engagement, practical experiences, and collaboration. For instance, a learning activity package to teach participants about instructional approaches in mathematics could involve collaborative problem-solving tasks where participants develop and test different teaching methods. This hands-on activity allows them to apply theoretical knowledge in a practical context, enhancing their understanding and ability to design effective instructional strategies. The content of each activity. (Table 1). The learning activity package was evaluated as appropriate ($\bar{x} = 4.90$) before the implementation by five experts including scholars in evaluation and assessment, education research, mathematics and learning management.

Table 1.
Learning activity package.

Package 1 Mathematics Learning Innovations	Package 2 Designing Mathematics Achievement Tests	Package 3 Designing Questionnaire on Mathematics Learning Satisfaction
Activity 1.1: Defining mathematics learning innovation. Activity 1.2: Designing Learning Management in Mathematics Activity 1.3: Defining specific terms. Activity 1.4: The quality of the learning management plan.	Activity 2.1: Structuring the exam. Activity 2.2: Developing an Academic Achievement Test. Activity 2.3: Test Validity. Activity 2.4: Item Analysis for Multiple-Choice Tests. Activity 2.5: Item Analysis for Essay.	Activity 3.1: Literature Review. Activity 3.2: Defining specific terms. Activity 3.3: Creating questions. Activity 3.4: Validity of the Questionnaire. Activity 3.5: Item Analysis for Questionnaire.

3.2.2. Learning Achievement Test

The learning achievement test was developed to assess participants' research skills concerning the instructed topics. It was designed as a multiple-choice test with a total of 30 question items. The content of the test covered areas related to mathematics learning innovations (9 items), designing mathematics achievement tests (12 items), and creating questionnaires on mathematics learning satisfaction (9 items). The test items were evaluated to ensure that their difficulty, discrimination, and reliability were at standardized levels, providing a robust measure of participants' research skills. The evaluation by experts indicates an Item-Objective Congruence (IOC) of 1.0 for all the items. The test consisted of 30 items, each with four choices, with appropriate difficulty levels (P=0.50-0.79) and discrimination (B-index=0.22-0.82). The reliability was 0.96 as Lovett tested.

3.2.3. Research Instrument Development Skills Form (Rubric Scoring)

Research instrument development skills form was developed as a rubric assessment. There are 19 evaluation criteria in total, covering the participants' skills in.

Developing learning management plans: Writing and evaluating learning management plans to address mathematical challenges in school courses (6 criteria, 18 scores).

Developing achievement tests: Creating and assessing the quality of mathematics achievement tests (7 criteria, 21 scores).

Developing questionnaires: Creating and assessing the quality of satisfaction questionnaires for learning management (6 criteria, 18 scores).

The scale ranged from 0 (no ability) to 3 (advanced ability) for each evaluating issue (Full mark = 57).

The research skills assessment form received a high appropriateness rating ($\bar{x} = 4.88$) from 5 experts, including scholars in evaluation and assessment, education research, mathematics, and learning management. The rubric scale was tested using the Rater Agreement Index (RAI) and yielded a score of 0.98. If the RAI is higher than .90, it is considered a big effect [28, 29].

3.3. Research Design and Data Collection

The research was structured using a quasi-experimental methodology. A one-Group Pretest-Posttest Design [30].

Before: Pre-test results of learning achievement.

Treatment: Learning activity package (LAP).

After: Assign tasks to participants, including conducting research to enhance mathematics learning grounded in the instructional methodology incorporated in the activity package. Then, it was measured using the research instrument development skills form and the post-test results of learning achievement.

3.4. Data Analysis

The data were assessed for normality using the Shapiro-Wilk test and Kolmogorov-Smirnov. If the p-value is greater than .05, the data is considered to follow a normal distribution [31], then a parametric statistic is used, but a non-parametric statistic is not.

The participants' learning achievement was evaluated through a comparative analysis of their pre-test and post-test scores, employing a dependent samples t-test.

The participants' research instrument development skills were analyzed by mean, standard deviation, and percentage. The participants' percentages were analyzed by the following interpretation: 81-100% = very high, 61-80% = high, 41-60% = moderate, 21-40% = low, and 1-20% = lowest, then analyzed using a one-sample t-test compared to the predetermined criterion of 75% of the full score.

4. Result

4.1. Test Normality

The data were assessed for normality using the Shapiro-Wilk test and Kolmogorov-Smirnov. The results indicated that all data followed a normal distribution ($p > .05$) (Table 2). Therefore, dependent samples t-test and one-sample t-test were used in the data analysis.

Table 2.
Normality of data distribution.

Dependent Variable	Kolmogorov-Smirnov			Shapiro-Wilk		
	Statistic	df	p-value	Statistic	df	p-value
Pre-test	0.139	25	0.200	0.945	25	0.191
Post-test	0.139	25	0.200	0.944	25	0.183
Research instrument development skills	0.161	25	0.093	0.927	25	0.073

4.2. Effects of Learning Activity Package on Participants' Learning Achievement

The results shown in Table 3 are findings that reveal a notable improvement in participants' learning achievement of the learning activity package. The post-test score ($\bar{x} = 23.32$, S.D = 3.41) was statistically significantly greater than the pre-test score ($\bar{x} = 10.40$, S.D = 1.98) at the .05 level, with paired differences of 12.92, t-test of 25.03, and a p-value below the .05. These results underscore the efficacy of the learning activity package in enhancing participants' learning achievement in the course called Research in Mathematics Learning at a public university in Thailand.

Table 3.
The comparison between participants' learning achievement test scores.

Achievement	$\bar{x}$	SD	Paired Differences		t-test	p-value
			$\bar{x}$	SD		
Pre-test	10.40	1.98	12.92	2.58	25.03	0.00*
Post-test	23.32	3.41				

Note: *p-value < 0.05.

4.3. Effects of learning activity package on participants' research instrument development skills

1) The participants' research instrument development skills were rated as "high" or "very high" in each evaluation criterion, with average scores indicating strong proficiency across the evaluated areas. The total average score for all skill areas combined was 47.00 out of a possible 57, reflecting a high level of skill proficiency (82.46%). (Table 4).

Table 4.
Participants research instrument development skills.

Research instrument development skills	Full mark	$\bar{x}$	SD	%	Skill Level
1. Developing learning management plans	18	14.52	2.24	80.67	High
1.1 Study of documents related to the teaching methods/techniques to be researched	3	2.32	0.56	77.33	High
1.2 Defining specific terms	3	2.36	0.49	78.67	High
1.3 Analyzing grade-level standards/indicators	3	2.44	0.51	81.33	Very high
1.4 Teaching guidelines for the unit/topic being researched	3	2.40	0.58	80.00	High
1.5 Writing learning management plans based on specific terms	3	2.36	0.57	78.67	High
1.6 Evaluating the quality of the learning management plans	3	2.64	0.49	88.00	Very high
2. Developing achievement tests	21	17.24	2.65	82.10	Very high
2.1 Structuring multiple-choice and subjective tests	3	2.48	0.65	82.67	Very high
2.2 Creating multiple-choice questions based on the test structure	3	2.40	0.71	80.00	High
2.3 Creating subjective questions and scoring criteria based on the test structure	3	2.36	0.49	78.67	High
2.4 Selecting experts	3	2.64	0.49	88.00	Very high
2.5 Analyzing the quality of multiple-choice questions	3	2.48	0.51	82.67	Very high
2.6 Analyzing the quality of subjective questions	3	2.40	0.50	80.00	High
2.7 Printing the final version of the test	3	2.48	0.51	82.67	Very high
3. Developing questionnaires	18	15.24	2.05	84.67	Very high
3.1 Defining specific terms	3	2.40	0.58	80.00	High
3.2 Structuring the satisfaction questionnaire for learning management	3	2.56	0.51	85.33	Very high
3.3 Creating questions based on specific terms	3	2.28	0.61	76.00	High
3.4 Selecting experts	3	2.64	0.49	88.00	Very high
3.5 Analyzing the quality of the satisfaction questionnaire for learning management	3	2.76	0.44	92.00	Very high
3.6 Printing the final version of the satisfaction questionnaire for learning management	3	2.60	0.50	86.67	Very high
Overall	57	47.00	6.49	82.46	Very high

2) The average score ($\bar{x}$ = 47.00, SD = 6.49) of participants' research instrument development skills was significantly higher than the predetermined criterion of 42.75 (75% of the full mark), $t = 3.27$, $p < 0.05$, reflecting the positive effect of the Learning Activity Package intervention. In detail, the participants' average scores in specific skill areas were also significantly higher than the criteria, suggesting that the learning activity package effectively developed educational research instrument skills to the expected level (Table 5).

Table 5.
The comparison between participants' skills and predetermined criteria.

Research instrument development skills	Fullmark	$\bar{x}$	SD	Criteria (75%)	t	p-value
1. Developing learning management plans	18	14.52	2.24	13.50	2.28	0.02*
2. Developing achievement tests	21	17.24	2.65	15.75	2.81	0.00*
3. Developing questionnaires	18	15.24	2.05	13.50	4.25	0.00*
Overall	57	47.00	6.49	42.75	3.27	0.00*

Note: *p-value < 0.05.

5. Discussion

The study's results indicate the significant benefits of the learning activity package in enhancing preservice teachers' learning achievement and research instrument development skills. These findings are consistent with previous studies, Agyei and Voogt [21], Anwer [22], Çakmak [23], Pulido Gil et al. [24], Agwu Udu et al. [25], Disathaporn et al. [26], Dar [27], Boonyawinit [32], and Jantamuttuakarn et al. [33], which have also demonstrated the positive impact of LAP in teacher education.

The specific mechanisms through which the learning activity package contributed to these improvements can be discussed in this study's results. The learning activity package is focused on active engagement, developing education research instruments skills, hands-on experiences, and collaboration, which likely played a crucial role in developing participants' skills. This aligns with Çakmak [23], who found that real-practice activities significantly enhanced learning achievement. By involving preservice teachers in practical activities that mirror real-world teaching scenarios, the learning activity package facilitates a deeper understanding and retention of instructional methods and research techniques. This

method contrasts traditional lecture-based approaches by encouraging critical thinking, problem-solving, and applying theoretical knowledge in practical settings.

Additionally, the learning activity package fosters a collaborative learning environment where participants can learn from each other, share insights, and develop their skills collectively. As discussed in Anwer [22], interaction among participants and teacher feedback played a crucial role in classroom success. In this study, peer interaction and feedback loops were essential for refining research design skills, allowing preservice teachers to explore different perspectives and approaches. The structured yet flexible nature of the learning activity package also ensures that participants can progress at their own pace, providing the necessary support to achieve the expected skill levels. The learning activity package also helps students develop conceptual understanding, helping to promote student learning, process skills, and thinking as students travel between the classroom and outside [34, 35].

The positive outcomes observed in this study underscore the effectiveness of the learning activity package in teacher education. By promoting active participation, practical application, and collaborative learning, the learning activity package significantly enhances preservice teachers' research design skills, preparing them for successful careers in education.

6. Conclusion

The current study employed a one-group pretest-posttest design to investigate the effects of the learning activity package on preservice teachers' learning achievement in research in mathematics teaching and research instrument development skills within the Thai educational context. The results reveal positive effects of the learning activity package on both qualifications. This study contributes to the field by exploring the use of a learning activity package in developing education research instrument skills, a crucial qualification for teacher development.

This study underscores the promising potential of the learning activity package in bolstering preservice teachers' development of educational research instrument skills. Future studies should delve into the influence of the learning activity package on other crucial teacher qualifications, such as classroom management, student engagement, and curriculum development. Expanding research to encompass diverse educational context and larger sample sizes will offer a more comprehensive understanding of the effectiveness of the learning activity package.

References

[1] M. Legge and W. Smith, "Teacher education and experiential learning: A visual ethnography," *Australian Journal of Teacher Education*, vol. 39, no. 12, pp. 95-110, 2014. https://doi.org/10.3316/informit.852580049030403

[2] P. T. Ng and E.-L. Low, "Teacher learning and development across the continuum: Pre-service to in-service," *Teacher Education in the 21st Century: Singapore's Evolution and Innovation,* pp. 267-281, 2017. https://doi.org/10.1007/978-981-10-3386-5_15

[3] O.-S. Tan, W.-C. Liu, and E.-L. Low, "Teacher education futures: Innovating policy, curriculum and practices," *Teacher Education in the 21st Century: Singapore's Evolution and Innovation,* pp. 1-9, 2017. https://doi.org/10.1007/978-981-10-3386-5_1

[4] C. Çetin and M. Bayrakcı, "Teacher professional development models for effective teaching and learning in schools," *The Online Journal of Quality in Higher Education*, vol. 6, no. 1, pp. 32-38, 2019.

[5] P. Singh, F. Hoyte, S. Heimans, and B. Exley, "Teacher quality and teacher education: A critical policy analysis of international and Australian policies," *Australian Journal of Teacher Education,* vol. 46, no. 4, pp. 1-15, 2021. https://doi.org/10.14221/ajte.2021v46n4.1

[6] S. Imig, S. Koziol, V. Pilato, and D. Imig, "Teacher certification and credentials: From a focus on qualification to a commitment to performance," *International Handbook of Research on Teachers and Teaching,* pp. 141-157, 2009. https://doi.org/10.1007/978-0-387-73317-3_9

[7] J. Oestar and C. Marzo, "Teachers as researchers: Skills and challenges in action research making," *International Journal of Theory and Application in Elementary and Secondary School Education,* vol. 4, no. 2, pp. 95-104, 2022.

[8] G. S. Hine, "The importance of action research in teacher education programs," *Issues in Educational research*, vol. 23, no. 2, pp. 151-163, 2013.

[9] S. Lindblom-Ylänne and L. Breslow, *The importance of evidence-based enhancement of the quality of learning and teaching in research-intensive universities," in Strengthening Teaching and Learning in Research Universities, B. Stensaker, G. Bilbow, L. Breslow, and R. van der Vaart, Eds*. Cham: Palgrave Macmillan, 2017.

[10] J. W. Willison, "Research skill development spanning higher education: Critiques, curricula and connections," *Journal of University Teaching and Learning Practice*, vol. 15, no. 4, pp. 1-15, 2018. https://ro.uow.edu.au/jutlp/vol15/iss4/1

[11] P. Fongkanta, F. S. Buakanok, A. Netasit, and S. Kruaphung, "Teacher professional development in research skill of teacher in non-formal education center, lampang, Thailand," *Journal of Education and Learning,* vol. 11, no. 1, pp. 125-131, 2022. https://doi.org/10.5539/jel.v11n1p125

[12] M. M. O. Assaff and K. A. Aburezeq, "Postgraduates' perceptions regarding their mastery level of educational research skills at the Palestinian faculties of education and ways to develop these skills," *African Educational Research Journal,* vol. 6, no. 3, pp. 148-159, 2018. https://doi.org/10.30918/AERJ.63.18.034

[13] I. Irfan, A. Prastowo, S. Fatonah, F. Malahati, P. Jannati, and U. A. Nurjanna, "Analysis of research skill in understanding research method to prospective teacher at Islamic elementary school," *JIP Jurnal Ilmiah PGMI,* vol. 9, no. 1, pp. 61-71, 2023. https://doi.org/10.19109/jip.v9i1.17090

[14] J. M. Reis-Jorge, "Developing teachers' knowledge and skills as researchers: A conceptual framework," *Asia-Pacific Journal of Teacher Education*, vol. 33, no. 3, pp. 303-319, 2005. https://doi.org/10.1080/13598660500286309

[15] V. Willegems, E. Consuegra, K. Struyven, and N. Engels, "How to become a broker: The role of teacher educators in developing collaborative teacher research teams," *Educational Research and Evaluation,* vol. 22, no. 3–4, pp. 173–193, 2016. https://doi.org/10.1080/13803611.2016.1247721

[16] L. Van Katwijk, E. Jansen, and K. Van Veen, "Pre-service teacher research: A way to future-proof teachers?," *European Journal of Teacher Education,* vol. 46, no. 3, pp. 435-455, 2023. https://doi.org/10.1080/02619768.2021.1928070

[17] W. Van Der Linden, A. Bakx, A. Ros, D. Beijaard, and M. Vermeulen, "Student teachers' development of a positive attitude towards research and research knowledge and skills," *European Journal of Teacher Education*, vol. 35, no. 4, pp. 401-419, 2012. https://doi.org/10.1080/02619768.2011.643401

[18] C. R. Duke, "Learning activity packages: Construction and implementation," *The High School Journal*, vol. 58, no. 7, pp. 312-321, 1975.

[19] M. Gibney, *Development methodology: Learning activity package. In M. B. Parks (Ed.), Learning activity packages*. Fort Lauderdale, FL: Nova Southeastern University, Programs for Higher Education, 2000.

[20] P. G. Kapfer and M. B. Kapfer, "Introduction to learning packages," *Educational Technology*, vol. 12, no. 9, pp. 9–11, 1972.

[21] D. D. Agyei and J. M. Voogt, "Pre-service mathematics teachers' learning and teaching of activity-based lessons supported with spreadsheets," *Technology, Pedagogy and Education*, vol. 25, no. 1, pp. 39-59, 2016. https://doi.org/10.1080/1475939X.2014.928648

[22] F. Anwer, "Activity-based teaching, student motivation and academic achievement," *Journal of Education and Educational Development*, vol. 6, no. 1, pp. 154-170, 2019.

[23] M. Çakmak, "Study in teacher education: Effects of activity-based instruction on student teachers' achievement," *İlköğretim Online*, vol. 15, no. 3, pp. 1043–1051, 2016. https://doi.org/10.17051/io.2016.29020

[24] J. M. Pulido Gil, D. Sánchez Oliva, M. Á. López Gajardo, J. C. Ponce Bordón, and T. García Calvo, "Effectiveness of a physically active learning program on indicators ofphysical activity, well-being and academic performance in students," *Cultura_Ciencia_Deporte*, vol. 52, no. 17, pp. 189–197, 2022. https://doi.org/10.12800/ccd.v17i52.1792

[25] D. Agwu Udu *et al.*, "Innovative pedagogy and improvement of students' knowledge retention in science education: Learning activity package instructional approach," *Pertanika Journal of Social Sciences & Humanities*, vol. 30, no. 3, pp. 1405–1426, 2022. https://doi.org/10.47836/pjssh.30.3.25

[26] C. Disathaporn, S. Kerdnoonwong, and C. Areekul, "Results of learning activity package for developing learning management competency of non-formal education teachers," *Pegem Journal of Education and Instruction*, vol. 14, no. 1, pp. 252-260, 2024. https://doi.org/10.47750/pegegog.14.01.28

[27] W. A. Dar, "Pedagogy for its own sake: teacher's beliefs about activity-based learning in rural government schools of Kashmir," *Quality Assurance in Education*, vol. 29, no. 2/3, pp. 311-327, 2021. https://doi.org/10.1108/QAE-01-2021-0013

[28] J. A. Burry-Stock, D. G. Shaw, C. Laurie, and B. S. Chissom, "Rater agreement indexes for performance assessment," *Educational and Psychological Measurement*, vol. 56, no. 2, pp. 251-262, 1996. https://doi.org/10.1177/0013164496056002006

[29] L. Bartok and M. A. Burzler, "How to assess rater rankings? A theoretical and a simulation approach using the sum of the pairwise absolute row differences," *Journal of Statistical Theory and Practice*, vol. 14, no. 3, p. 37, 2020. https://doi.org/10.1007/s42519-020-00103-w

[30] G. J. Privitera, *Research methods for the behavioral sciences*. Thousand Oaks, CA: Sage Publications, 2014.

[31] C. Avram and M. Măruşteri, "Normality assessment, few paradigms and use cases," *Romanian Journal of Laboratory Medicine*, vol. 30, no. 3, pp. 251-260, 2022. https://doi.org/10.2478/rrlm-2022-0030

[32] M. Boonyawinit, "Development of learning activity package to promote learning management that support student's online learning motivation for teachers primary education," *Journal of Social Science and Cultural*, vol. 7, no. 11, pp. 180–191, 2023.

[33] U. Jantamuttuakarn, K. Wongtamart, N. Disom, and P. Pradabsri, "The development of learning activities package learning management design project-based learning and STEM Education of Student Teachers at Surin Rajabhat University," *Journal for Developing the Social and Community*, vol. 10, no. 3, pp. 271–290, 2023.

[34] D. Sun, C.-K. Looi, Y. Yang, and J. Sun, "Design and implementation of the boundary activity based learning (BABL) principle in science inquiry: An exploratory study," *Educational Technology & Society*, vol. 23, no. 4, pp. 147-162, 2020.

[35] E. F. S. Rini and F. T. Aldila, "Practicum activity: analysis of science process skills and students' critical thinking skills," *Integrated Science Education Journal*, vol. 4, no. 2, pp. 54-61, 2023. https://doi.org/10.37251/isej.v4i2.322