Prisma Sains: Jurnal Pengkajian Ilmu dan Pembelajaran Matematika dan IPA IKIP Mataram
https://e-journal.undikma.ac.id/index.php/prismasains/index
e-mail: prismasains.pkpsm@gmail.com

April 2026. Vol. 14, No. 2
p-ISSN: 2338-4530
e-ISSN: 2540-7899
pp. 480-490

The Effect of Teachers' Creative Models on Students' HOTS in Digital Mathematics Learning

[1]*Kenys Fadhilah Zamzam, [1]Asri Putri Anugraini, [2]Susandi
[1]Department of Mathematic Education, Universitas Insan Budi Utomo, Malang, Indonesia
[2]Department of Indonesian Language and Literature, Universitas Insan Budi Utomo, Malang, Indonesia
*Corresponding Author e-mail: kenysfz@gmail.com

Received: February 2026; Revised: March 2026; Published: April 2026

Abstract

Developing higher-order thinking skills (HOTS) in mathematics education remains a challenge, particularly regarding the use of technology, which often serves merely as a medium for delivering content without innovation in task design. Unlike previous studies that focused on the use of technology or instructional models, this study positions teachers' creativity in designing digital tasks as the primary factor influencing HOTS and student engagement. This study aims to analyze the influence of teachers' creative models on HOTS skills and the engagement of junior high school students. The study employs a quantitative approach with a quasi-experimental design involving 120 students. Teachers' creative models were identified through analysis of digital assigments products and classroom observations, then classified based on indicators of context, problem-solving procedures, and assignment structure in digital format into four levels: imitation, transition, modification, and construction. Data were collected through HOTS tests and student engagement questionnaires, then analyzed using ANOVA. The results showed that there were significant differences in students' HOTS abilities and engagement based on the level of the teacher's creative model. Students at the modification and construction levels demonstrated higher results. These findings confirm that the quality of creative digital assignment design is key to enhancing technology-based mathematics learning.

Keywords: Teacher creativity; HOTS; Digital learning; Mathematics education

How to Cite: Zamzam, K. F., Anugraini, A. P., & Susandi, S. (2026). The Effect of Teachers' Creative Models on Students' HOTS in Digital Mathematics Learning. *Prisma Sains: Jurnal Pengkajian Ilmu Dan Pembelajaran Matematika Dan IPA IKIP Mataram*, *14*(2), 480–490. https://doi.org/10.33394/j-ps.v14i2.19739

https://doi.org/10.33394/j-ps.v14i2.19739

INTRODUCTION

The development of digital technology has brought significant changes to learning practices, including mathematics learning in schools. Technology integration not only functions as a medium for delivering material but also as a means of creating interactive, contextual, and meaningful learning experiences (Alimuddin et al., 2023; Joklitschke et al., 2021). Previous studies have shown that the use of technology in mathematics education can enhance motivation and conceptual understanding; however, its effectiveness depends heavily on how the technology is integrated into the instructional design, rather than simply serving as a visual aid or a medium for presenting content. In the context of 21st- century education, mathematics learning is expected to develop higher-order thinking skills (HOTS), which include the ability to analyze, evaluate, and create. These skills are important because mathematics emphasizes not only mastery of concepts but also reasoning and problem- solving skills in non-routine situations (Pourdavood & Yan, 2021; Purwasi & Fitriyana, 2020).

However, various findings show that students' higher-order thinking skills in mathematics learning are not yet optimal. One of the reasons for this is that learning practices are still oriented towards routine and procedural exercises. The tasks given to students are often mechanistic, lack context, and do not provide space for deep thinking exploration. In digital learning situations, this problem becomes even more complex because the use of technology often only serves as a substitute for conventional media without being accompanied by innovation in the design of learning tasks. Previous research has also confirmed that task design plays a crucial role in determining the quality of students' thinking processes, with open-ended, contextual, and challenging tasks being more effective in fostering higher-order thinking skills (HOTS) than closed-ended and routine tasks. In this context, teachers have a strategic role as designers of learning experiences. Teacher creativity is an important factor in designing learning tasks that encourage active engagement and higher-order thinking processes (Nasution & Tambunan, 2024; Kim, 2023; Elgrably & Leikin, 2021; Schindler & Lilienthal, 2020). Nevertheless, most studies still view teacher creativity in general terms and have not specifically linked it to the quality of the resulting digital tasks. Creative teachers not only utilize technology as a tool, but are also able to design digital tasks that are relevant to students' experiences, visually appealing, and cognitively challenging. One form of teacher creativity implementation is the development of child-friendly digital tasks, which are tasks designed with consideration of student developmental characteristics, clear instructions, attractive appearance, proportional difficulty levels, and provide a fun learning experience without causing pressure (Chen et al., 2023; Zamzam & Wijayanti, 2022).

The level of teacher creativity in developing digital tasks can be seen through the creative model used. The teacher's creative model describes the level of innovation in designing learning tasks, ranging from imitating existing tasks (imitation), making limited adjustments (transition), making more significant changes in context and presentation (modification), to designing completely new and innovative tasks (construction) (Zamzam et al., 2026). Unlike previous studies, which have not classified teacher creativity in an operational and structured manner, this four-level model offers a more systematic conceptual framework for identifying, distinguishing, and measuring levels of teacher creativity in the design of digital tasks. The higher the level of the teacher's creative model, the greater the opportunity for creating non-routine, contextual, and challenging tasks, thereby stimulating deep thinking processes in students (Zamzam et al., 2023; Subanji et al., 2021). In mathematics learning, the quality of the tasks given greatly determines the development of students' higher-order thinking skills. HOTS includes the ability to analyze relationships between concepts, evaluate solution strategies, and create new solutions to problems (Murangira et al., 2024; Abdallah, 2023; Levenson, 2015) These abilities develop through learning experiences that require non-routine problem solving, the use of various strategies, and logical reasoning. Therefore, the design of challenging, contextual, and open-ended tasks is an important factor in the development of HOTS.

Conceptually, the teacher's creative model is closely related to students' higher-order thinking skills (Dwi et al., 2022; Aurelia, 2021; Beghetto & Karwowski, 2018; Sriraman & Dickman, 2017). Tasks developed through a low creativity model tend to be routine and procedural, thus only developing lower-order thinking skills. Conversely, tasks designed through higher creativity models, particularly at the modification and construction levels, enable students to face problem situations that require analysis, evaluation, and the creation of new strategies. However, there remains a research gap: few studies have empirically examined the relationship between the level of teachers' creative models in the design of digital tasks and students' higher-order thinking skills (HOTS), particularly in the context of child-friendly digital tasks. Although various studies have examined the use of technology in mathematics learning and the influence of task design on student learning outcomes, research that specifically examines the influence of the level of teacher creativity in the development of child-friendly digital tasks on students' higher-order thinking skills is still limited. Most studies emphasize the use of certain media or learning models without examining teacher creativity as a key factor in task design.

Based on this description, this study aims to analyze the influence of teachers' creative models in developing child-friendly digital tasks on students' higher-order thinking skills in mathematics learning. This study also examines the level of teacher creativity and the differences in students' higher-order thinking skills at each level of creativity used. This study is therefore expected not only to fill existing research gaps but also to offer a new contribution in the form of an operational framework for classifying teacher creativity that can serve as a foundation for developing more innovative digital learning designs. The results of this study are expected to contribute theoretically to the development of studies on teacher creativity and practically to the improvement of the quality of digital task design that is more innovative and oriented towards the development of students' HOTS.

METHOD

Research Design

This study uses a quantitative approach with a quasi-experimental design to analyze the influence of teacher creative models in developing child-friendly digital tasks on higher-order thinking skills (HOTS) and student engagement in mathematics learning. A quasi-experimental design was chosen because the research was conducted in a real learning situation without fully randomizing the subjects. The independent variable in this study was the level of the teacher's creative model in developing digital tasks, consisting of imitation, transition, modification, and construction. The dependent variables in this study were students' higher-order thinking skills and their level of engagement in learning. This study employed a cross-group comparative design with different treatments at each level of the teacher's creative model to strengthen causal inferences, and ensured baseline equivalence in student abilities through pre-test analysis based on prior academic performance.

Population and Sample

The research population consisted of all junior high school students who participated in digital task-based mathematics learning at the schools where the research was conducted. The research sample was taken using purposive sampling with the following criteria: (1) students participated in mathematics learning using digital tasks, (2) teachers had developed child-friendly digital tasks that could be classified based on the level of creative model, and (3) students had experience using digital devices in learning. The research sample consisted of several classes representing differences in the level of teachers' creative models. A total of 120 students were divided proportionally into four groups, each consisting of 30 students, representing the levels of teachers' creative models (imitation, transition, modification, and construction). Each group was drawn from different classes but was relatively homogeneous in terms of initial ability and academic background.

Research Instruments

Data collection was conducted using two types of instruments, namely HOTS tests and student engagement questionnaires. HOTS tests were used to measure students' higher-order thinking skills based on the revised Bloom's taxonomy indicators, which include the ability to analyze (C4), evaluate (C5), and create (C6). The questions were compiled in the form of non-routine descriptions that required mathematical reasoning, problem solving, and the ability to select and explain solution strategies. The HOTS test consists of six open-ended questions with an analytical scoring rubric that assesses conceptual accuracy, the quality of strategies, and the clarity of reasoning, with a score range of 0–4 for each indicator. This instrument was validated by mathematics education experts and tested to determine the reliability, level of difficulty, and discriminating power of the questions. The validity test results indicate that all test items fall into the valid category, with a reliability coefficient (Cronbach's Alpha) of >0.80, indicating high internal consistency, and difficulty and discriminative power levels ranging from moderate to good. The student engagement questionnaire was used to measure the level of student participation during learning using digital tasks. Student engagement was measured through three aspects, namely cognitive engagement, emotional engagement, and behavioral engagement. The questionnaire instrument was compiled in the form of a Likert scale and developed based on 21st- century learning indicators that emphasize independent learning activities, interaction with digital media, and active participation in completing tasks. The questionnaire consists of 20 statements on a 1–5 Likert scale, covering a range of items across each aspect of engagement. The reliability test results showed a Cronbach's Alpha value of >0.85, indicating very high reliability, and the construct validity test results showed that all items met the validity criteria. This instrument was also validated by experts and tested for reliability before being used in the study.

Research Procedures

The research was conducted in several stages, including preliminary studies, identification of the use of digital tasks in mathematics learning, classification of teachers' creative model levels based on analysis of problem contexts, solution procedures, and digital task structures, implementation of learning using child-friendly digital tasks, administration of HOTS tests, distribution of student engagement questionnaires, and data processing and analysis. The classification of teachers' creative models was conducted using an analysis rubric developed by the researcher based on three main indicators: context, problem-solving procedures, and task structure in a digital format. Each digital task was analyzed by two independent raters to ensure consistency in classification, with a high level of inter-rater reliability. The systematic flow of the research implementation is presented in Figure 1.

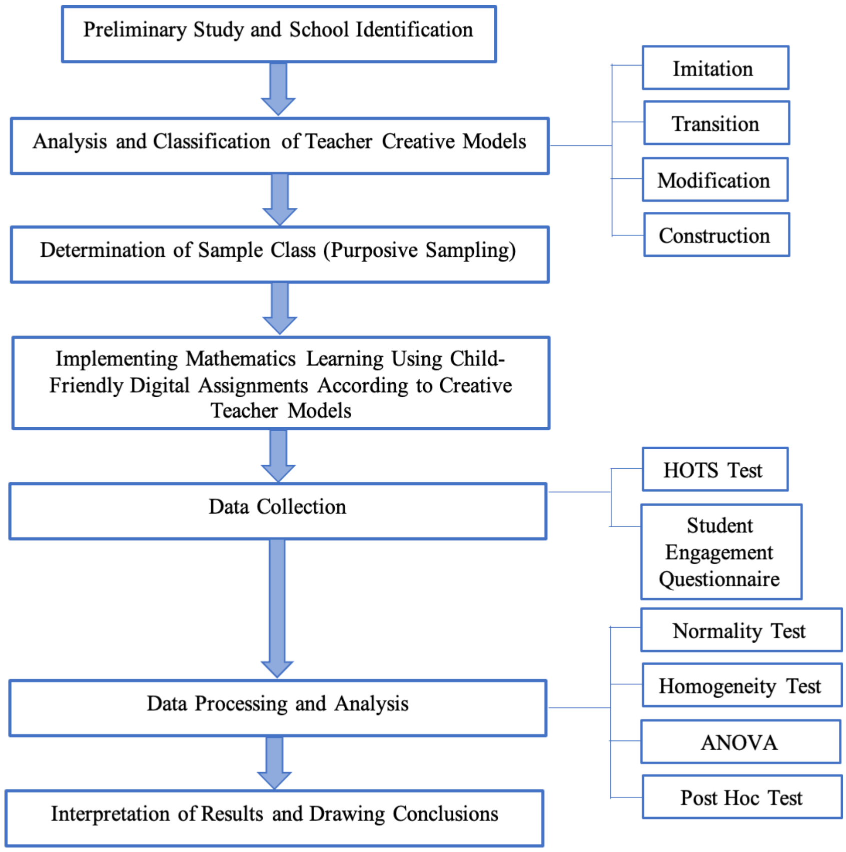

Figure 1. Research Implementation Flow

Data Analysis

Data analysis was conducted through descriptive and inferential analysis. Descriptive analysis was used to describe the average HOTS ability and level of student engagement in each group of teacher creative models. Before further analysis, the data was tested using prerequisite tests, including normality and homogeneity tests. Next, inferential analysis was performed using a one-way ANOVA test to determine the differences in HOTS abilities and student engagement based on the level of the teacher's creative model. If there were significant differences, a post hoc test was performed to determine the groups that were significantly different. In addition, this study began with a pilot test on a limited sample to ensure the clarity of the instruments, the reliability of the learning procedures, and the validity of the teachers' creative model classification before the main study was conducted.

This research design is relevant to the demands of mathematics learning in the digital age, which emphasizes the development of digital literacy and 21st-century skills (Noble & Smith, 2024; Creswell, 2018; Denzim & Lincoln, 2018). The use of child-friendly digital tasks is expected to not only improve students' higher-order thinking skills but also encourage active engagement, independent learning, and the ability to interact effectively with technology as part of 21st-century learning competencies.

RESULTS AND DISCUSSION

The results of the study indicate that the level of teachers' creative models in developing child-friendly digital tasks has an influence on higher-order thinking skills (HOTS) and student engagement in mathematics learning. Descriptive analysis shows a tendency for HOTS scores and student engagement to increase along with the level of teachers' creative models. As shown in Table 1, the average HOTS ability of students in the imitation group was 62.45 and increased gradually in the transition group (68.32), modification group (74.87), and reached the highest value in the construction group at 82.15. The same pattern was also seen in student engagement, where the average score increased from 2.85 in the imitation group to 3.78 in the construction group. In addition to the mean, the descriptive analysis also shows that the standard deviation in each group is relatively homogeneous, indicating that the distribution of data does not vary significantly across groups. These findings indicate that the higher the level of teacher creativity in designing digital tasks, the higher the quality of cognitive processes and student participation in learning. Overall, the data in Table 1 show a consistent upward trend from the imitation stage to the construction stage, which supports the existence of a linear relationship between teachers' creativity levels and student learning outcomes.

Table 1. Average ability

Creative Model	N	Mean HOTS	SD HOTS	Mean Engagement	SD Engagement
Imitation	30	62.45	8.21	2.85	0.41
Transition	30	68.32	7.95	3.12	0.38
Modification	30	74.87	7.40	3.45	0.36
Construction	30	82.15	6.88	3.78	0.34
Total	120	71.95	9.12	3.30	0.45

An ANOVA test was conducted to determine the significance of these differences. The data met the assumptions of normality ($p > 0.05$) and homogeneity of variances ($p > 0.05$) prior to the ANOVA test, making them suitable for further analysis using one-way ANOVA. The results of the analysis showed that there was a significant difference in students' HOTS abilities based on the level of the teacher's creative model ($F = 18.72$; $p < 0.05$), as shown in Table 2. The same was found in the student involvement variable, where the ANOVA test results showed significant differences between groups ($F = 16.35$; $p < 0.05$), as shown in Table 3. The effect size values indicate that the influence of teachers' creative models on HOTS skills is relatively large ($\eta^2 = 0.37$), as is the case with student engagement ($\eta^2 = 0.30$). This suggests that variations in student learning outcomes are substantially influenced by differences in the level of teachers' creative models when designing digital tasks. These findings indicate that the teacher's creative model is a factor that influences the quality of students' learning processes in digital-based mathematics learning. More specifically, Tables 2 and 3 show that between-group variation is more pronounced than within-group variation, which reinforces the significance of the differences found.

Table 2. Result of the HOTS ability ANOVA test

Source of Variation	JK	df	MK	F	Sig.
Between Group	6120.45	3	2040.15	18.72	0.000
Within Group	12640.30	116	108.97		
Total	18760.75	119			

Table 3. ANOVA test result for student engagement

Source of Variation	JK	df	MK	F	Sig.
Between Group	8.42	3	2.81	16.35	0.000
Within Group	19.93	116	0.17		
Total	28.35	119			

A post hoc Tukey test was conducted to identify groups with significant differences. The analysis results showed that almost all group pairs had significant differences, especially between groups with low and high creativity levels. As shown in Table 4, the construction group had significantly higher HOTS scores than the imitation, transition, and modification groups. The most striking difference was observed between the imitation and construction groups, which showed the largest mean difference and the strongest statistical significance ($p < 0.01$). The same pattern was also found in student engagement (Table 5), where groups with higher creative models showed better engagement levels. The results of the Tukey test also show that the differences between the transition and modification groups began to show a significant increase, indicating that changes to the task design at the intermediate level have already had an impact on student learning outcomes. A comparison of the results in Table 4 and Table 5 shows that the improvement was not only gradual but also statistically significant in nearly all group comparisons.

Table 4. HOTS post hoc test (Tukey)

Group Comparison	Mean Difference	Sig.
Imitation - Transition	-5.87	0.032
Imitation - Modification	-12.42	0.000
Imitation - Construction	-19.70	0.000
Transition - Modification	-6.55	0.018
Transition - Construction	-13.83	0.000
Modification – Construction	-7.28	0.011

Table 5. Post hoc student engagement test (Tukey)

Group Comparison	Mean Difference	Sig.
Imitation - Transition	-0.27	0.041
Imitation - Modification	-0.60	0.000
Imitation - Construction	-0.93	0.000
Transition - Modification	-0.33	0.022
Transition - Construction	-0.66	0.000
Modification - Construction	-0.33	0.036

Scientifically, this tendency for increased HOTS and student engagement occurs due to differences in the characteristics of the tasks produced at each level of the creative model. At the imitation level, digital tasks tend to be routine and procedural, requiring only the reproduction of knowledge. Conversely, at the modification and construction levels, the tasks given are more contextual, open-ended, and require non-routine problem solving. These conditions encourage students to analyze, evaluate strategies, and develop alternative solutions, which are the main characteristics of higher-order thinking skills in mathematics learning. This study's findings thus not only demonstrate the existence of statistically significant differences but also provide empirical evidence that the quality of digital tasks designed by teachers to foster creativity makes a tangible contribution to improving students' higher-order thinking skills and engagement.

The increase in student engagement can also be explained through the perspective of digital literacy and 21st-century learning. Creatively designed digital tasks are more interactive, challenging, and relevant to students' experiences, thereby increasing cognitive, emotional, and behavioral engagement. Active interaction with digital media encourages independent learning, information exploration, and the ability to manage the learning process independently as part of 21st-century competencies (Putra & Akbar, 2025).

Research findings indicate that an increase in the level of teachers' creative models is directly proportional to an increase in students' higher-order thinking skills. Theoretically, these results can be explained through the characteristics of tasks produced at each level of creativity. Tasks at the imitation level tend to be routine and procedural, requiring only the reproduction of knowledge. Conversely, at the modification and construction levels, the tasks developed are contextual, open-ended, and require non-routine problem-solving. Recent research shows that open-ended and cognitively challenging mathematics tasks have a significant influence on the development of analytical, evaluative, and new strategy creation skills as indicators of HOTS (Alshammari, 2024; Leikin & Pantazi, 2023). This explains why students who learn with high-creativity digital tasks demonstrate better HOTS scores.

From a mathematics learning perspective, these research results support the view that task design quality is a major factor in developing higher-order thinking skills. Schoenfeld emphasizes that effective mathematics learning must place students in problem-solving situations that require reasoning and decision-making (Schoenfeld, 2016). Recent studies also show that the use of technology in mathematics learning only has a positive impact when accompanied by task design that emphasizes concept and strategy exploration, not merely the digitization of material (Nielsen & Budiardjo, 2023; Easterday, 2021; Schindler & Lilienthal, 2020). Thus, the influence of the teacher's creative model in this study occurred not because of the use of technology alone, but because of the quality of the learning experience designed through digital tasks.

The increase in student engagement in groups with higher creative models can also be explained through the theory of learning engagement and digital literacy. Creatively designed digital tasks generally have interactive elements, attractive visuals, and provide challenges that are appropriate to the students' abilities. Recent research shows that interactive digital learning designs can increase students' cognitive and emotional engagement, which ultimately contributes to improved learning outcomes (Davis & Brown, 2021; Johnson & Lee, 2020). In the context of digital literacy, this engagement reflects students' ability to actively interact with technology, manage information, and develop learning independence, which are important parts of 21st- century competencies (Orbanus et al., 2024). These results confirm and expand upon previous findings by demonstrating that student engagement is influenced not only by technology but also by the level of creativity in the design of the tasks used.

The findings of this study also show a gradual pattern of improvement from the imitation to construction levels. This pattern indicates that teacher creativity is a spectrum of development, not a dichotomous condition. These results are in line with creativity development theory, which states that creativity develops through a gradual process from reproduction to innovation (Limbong et al., 2024; Baer & Kaufman, 2022). Other studies also show that teachers' ability to design creative learning is influenced by experience, technological literacy, and pedagogical courage to innovate (Amabile & Pratt, 2021). The unique contribution of this study lies in the provision of a four-level operational framework (imitation, transition, modification, construction) that enables the identification and measurement of teacher creativity in a more systematic and quantifiable manner than in previous studies.

Compared to previous studies, this study makes a more specific contribution by showing that the level of teacher creativity in digital task design has a direct influence on two important aspects, namely higher-order thinking skills and student engagement. Most previous studies have focused more on the effectiveness of digital media or specific learning models, while this study places teacher creativity as a key variable in technology integration. These findings reinforce the results of studies by Kim and Leikin, which show a positive relationship between a creative learning environment and the development of students' higher-order thinking skills (Kim, 2023; Leikin & Elgrably, 2022). Therefore, this study makes a new contribution by integrating the concepts of teacher creativity, digital task design, and higher-order thinking skills (HOTS) into a single, empirically validated framework. From a 21st-century learning perspective, the results of this study emphasize that the integration of technology in mathematics learning needs to be directed towards the development of critical thinking, problem-solving, and independent learning skills. Digital tasks developed through a high-level creative model enable students to play an active role in constructing knowledge, exploring various strategies, and reflecting on their thinking processes. Therefore, strengthening teachers' digital literacy is not only about the technical aspects of device use, but also needs to focus on creative learning design skills oriented towards the development of HOTS.

Overall, this discussion shows that the influence of teachers' creative models on HOTS and student engagement occurs through pedagogical mechanisms, namely improving the quality of cognitive challenges, contextual relevance, and the interactivity of digital tasks. These findings reinforce the position of teacher creativity as a key factor in creating effective digital-based mathematics learning that is relevant to the demands of 21st-century education. However, this study has limitations, particularly regarding its quasi-experimental design, which does not fully utilize randomization; therefore, causal inferences should be interpreted with caution. Additionally, the study's limited scope restricted to a specific number of schools and sample characteristics may affect the generalizability of the results. Therefore, future research is recommended to employ a stronger experimental design and include a broader sample to test the consistency of these findings.

CONCLUSION

This study shows that there are differences in higher-order thinking skills (HOTS) and student engagement based on the level of teachers' creative models in the development of child-friendly digital tasks. Students who learn with digital tasks at higher levels of creativity (modification and construction) tend to have better HOTS scores and higher levels of engagement compared to those at other levels. These findings suggest that the quality of digital tasks designed by teachers is associated with improvements in students' cognitive processes and participation in mathematics learning. Thus, this study contributes to reinforcing the role of teacher creativity as a key factor in digital learning design and provides a four-level operational framework of the creativity model that can be utilized in future research. However, given that this study employed a quasi-experimental design without full randomization, the results should be interpreted cautiously and are not intended to establish an absolute causal relationship. Additionally, limitations in the sample context and research setting restrict the generalizability of the findings. Based on these findings, it is recommended that the development of teacher competencies focus not only on the use of technology but also on the ability to design creative, contextual, and challenging digital tasks to support the development of higher-order thinking skills (HOTS) and student engagement in mathematics learning.

RECOMMENDATION

Subsequent research is suggested to expand the subject coverage and context at different levels of education as well as subjects in order to test the consistency of the influence of the teacher's creative model on HOTS abilities and student involvement. Research designs can be developed using pure experiments or mixed methods approaches to obtain a more comprehensive picture of learning outcomes and processes, including the development of training programs to increase teacher creativity in designing digital assigment. In addition, follow-up research needs to consider factors that could potentially influence outcomes, such as digital literacy of teachers and students, readiness of technological infrastructure, as well as characteristics of learning environments. Some obstacles that may arise include limited facilities and internet access, variations in technological capabilities, student learning motivation, school support, and limited learning time, so these factors need to be controlled or considered so that research results are more valid and generalizable.

ACKNOWLEDGMENTS
The authors would like to express their deepest appreciation to all members of the research team, for their invaluable support throughout the implementation of this study, as well as to the students who were indirectly involved in the research process. Special thanks are also extended to the teachers and students of Junior High School in Malang, whose active participation and meaningful contributions greatly enriched every stage of data collection and the implementation of the instructional design cycles. In addition, the authors convey their sincere gratitude and highest appreciation to the experts and fellow researchers who provided constructive feedback and validation, thereby enhancing both the conceptual depth and methodological rigor of this study.

FUNDING INFORMATION
This research was self-funded by the author. No external financial support, grants, or institutional funding were received for the conduct of this study, the analysis of the data, or the preparation of the manuscript. All costs related to the research process, including data collection, analysis, and publication, were covered personally by the author.

AUTHOR CONTRIBUTIONS STATEMENT

Name of Author	C	M	So	Va	Fo	I	R	D	O	E	Vi	Su	P	Fu
Kenys Fadhilah Zamzam	✓	✓		✓	✓	✓	✓	✓	✓			✓	✓	✓
Asri Putri Anugraini		✓	✓		✓	✓	✓	✓		✓	✓			✓
Susandi		✓		✓	✓	✓	✓	✓		✓	✓			✓

CONFLICT OF INTEREST STATEMENT
The authors state that they have no conflict of interest related to the research, authorship, or publication of this article.

INFORMED CONSENT
We have obtained informed consent from all individuals included in this study.

ETHICAL APPROVAL
The research related to human use has been complied with all the relevant national regulations and institutional policies in accordance with the tenets of the Helsinki Declaration and has been approved by the authors' institutional review board or equivalent committee.

DATA AVAILABILITY
Data availability is not applicable to this paper as no new data were created or analyzed in this study.

REFERENCES

Abdallah, A. K. (2023). Induction Programs' Effectiveness in Boosting New Teachers' Intruction and Student Achievement: A Critical Review. *International Journal of Learning, Teaching and Educational Research*, *22*(5), 493–517. https://doi.org/10.26803/ijlter.22.5.25

Alimuddin, A. J., Juntak, J., & Jusnita, R. (2023). Teknologi dalam Pendidikan: Membantu Siswa Beradaptasi dengan Revolusi Industri 4.0. *Journal on Education*, *5*(4), 11777–11790. https://doi.org/10.31004/joe.v5i4

Alshammari, S. H. (2024). The effects of technical skills, attitudes, and knowledge on students' readiness to use 4.0 industrial revolution technologies in education. *International Journal of Education in Mathematics, Science, and Technology (IJEMST)*, *12*(1), 40–52. https://doi.org/10.46328/ijemst.3638

Amabile, T. M., & Pratt, M. (2021). Creativity and the social environment: An updated componential theory. *Creativity Research Journal, 33*(4), 1–15. https://doi.org/10.1080/10400419.2021.1982099

Aurelia, F. (2021). Students creative thinking profile as a high order thinking in the improvement of mathematics learning. *European Journal of Educational Research*, *10*(3), 1247–1258. https://doi.org/10.12973/eu-jer.10.3.1247

Baer, J., & Kaufman, J. C. (2022). Teaching for creativity: Domain-specific approaches and iterative development. *Journal of Creative Behavior*, *56*(3), 570–582. https://doi.org/10.1002/jocb.527

Beghetto, R. A., & Karwowski, M. (2018). Educational consequences of creativity: A creative learning perspective. *Creativity. Theories Research Applications*, *5*(2), 146–154. https://doi.org/10.1515/ctra-2018-0011

Chen, L., Wang, Y., & Li, X. (2023). Designing Interactive Digital Learning Materials for Young Learners. *Educational Technology Journal*, *45*(2), 112–125.

Creswell, J. W. (2018). *Research Design:Qualitative, Quantitative, and Mixed Methods Approaches (5th ed.)*. Sage Publications.

Davis, A., & Brown, B. (2021). *The Innovative Educator: Fostering Creativity in Digital Pedagogy*. Routledge.

Denzim, N. K., & Lincoln, Y. S. (2018). *The SAGE Handbook of Qualitative Research*. Sage Publications.

Dwi, R., Manuharawati, M., & Khabibah, S. (2022). Activist learners' creative thinking processes in posing and solving geometry problem. *European Journal of Educational Research*, *11*(1), 117–126. https://doi.org/10.12973/eu-jer.11.1.117

Easterday, M. W. (2021). Design-based research synthesis: Developing design principles and theoretical contributions for learning environments. *Journal of the Learning Sciences*, *30*(3), 383–418. https://doi.org/10.1080/10508406.2020.1864052

Elgrably, H., & Leikin, R. (2021). Creativity as a function of problem-solving expertise: Posing new problems through investigations. *ZDM – Mathematics Education*, *53*(4), 891–904. https://doi.org/10.1007/s11858-021-01228-3

Johnson, R., & Lee, L. (2020). 21st Century Skills in a Digital Age: A Framework for Educators. *Journal of Educational Psychology*, *88*(4), 567–580.

Joklitschke, J., Rott, B., & Schindler, M. (2021). Notions of creativity in mathematics education research: A systematic literature review. *International Journal of Science and Mathematics Education*, *20*, 1161–1181. https://doi.org/10.1007/s10763-021-10192-z

Kim, K. H. (2023). Creativity assessment: Past, present, and future. *Psychological Science in the Public Interest*, *24*(1), 1–31.

Leikin, R., & Elgrably, H. (2022). Strategy creativity and outcome creativity when solving open tasks: Focusing on problem posing through investigations. *ZDM – Mathematics Education*, *54*(1), 35–49. https://doi.org/10.1007/s11858-021-01319-1

Leikin, R., & Pantazi, P. D. (2023). Creative Thinking in Mathematics Education: What is it, why is it important and how to foster it? *ZDM–Mathematics Education*, *55*(2), 223–236. http://dx.doi.org/10.1007/s11858-012-0459-1

Levenson, E. (2015). *Creativity and mathematics education: An intersection of two worlds*. *47*(2), 195–208.

Limbong, C. Y., Sindi Rotua Pardede, Dahlia Padang, & Etri Rehenda. (2024). Bermain sambil belajar: Strategi Pembelajaran Kreatif di Pendidikan Anak Usia Dini ramah anak. *Kiddo: Jurnal Pendidikan Islam Anak Usia Dini*, 521–530. https://doi.org/10.19105/kiddo.v1i1.12740

Murangira, F., Uworwabayeho, A., & Twagilimana, I. (2024). Teachers' Perceptions towards Practical Instruction Approach in Teaching Mathematics: A case of Selected Teachers in

Ugandan Secondary Schools. *International Journal of Learning, Teaching and Educational Research*, *23*(10), 415–434. https://doi.org/10.26803/ijlter.23.10

Nasution, M., & Tambunan, E. (2024). Development of Flashcard Media on Reproductive System Material to Enhance Highschool Students' Higher-Order Thinking Skills. *Prisma Sains : Jurnal Pengkajian Ilmu Dan Pembelajaran Matematika Dan IPA IKIP Mataram, 12*(3), 519–527. https://doi.org/10.33394/j-ps.v12i3.12152

Nielsen, J., & Budiardjo, S. (2023). Observing teacher-student interaction with technology in the classroom: A participatory approach. *Journal of Educational Technology & Society*, *26*(4), 112–125.

Noble, H., & Smith, J. (2024). Triangulation in qualitative research: A systematic review. *Qualitative Research Journal*, *24*(2), 154–171.

Orbanus, N., Wullur, M. M., & Modigir, N. (2024). The Role Of Digital Technology To Enhance Creativity And Innovation Skills For Learners In The 21st Century Era. *Journal Eduvest*, *4*(10), 9646–9653. http://dx.doi.org/10.59188/eduvest.v4i10.38826

Pourdavood, R., & Yan, M. (2021). *Preparing Teachers to Teach Mathematics using Integrated Digital Approaches: Implications for Higher Order Thinking*. *20*(1), 64–85. https://doi.org/10.26803/ijlter.20.1

Purwasi, L. A., & Fitriyana, N. (2020). Pengembangan Lembar Kerja Peserta Didik (LKPD) Berbasis Higher Order Thinking Skill (HOTS). *AKSIOMA Journal*, *9*(1), 894–908. https://doi.org/10.24127/ajpm.v9i4.3172

Putra, E. D., & Akbar, A. M. (2025). Analysis of Students' Critical Thinking Skills in Solving Ethnomathematics Problems. *Prisma Sains : Jurnal Pengkajian Ilmu Dan Pembelajaran Matematika Dan IPA IKIP Mataram*, *13*(4), 987–998. https://doi.org/10.33394/j-ps.v13i4.17474

Schindler, M., & Lilienthal, A. J. (2020). Students' creative process in mathematics: Insights from eye-tracking-stimulated recall interview on students' work on multiple solution tasks. *International Journal of Science and Mathematics Education*, *18*(8), 1565–1586. https://doi.org/10.1007/s10763-019-10033-0

Schoenfeld, A. H. (2016). Learning to think mathematically: Problem solving, metacognition, and sense making in mathematics. *Journal of Education*, *196*(2), 1–38. https://doi.org/10.1177/002205741619600202

Sriraman, B., & Dickman, B. (2017). Mathematical pathologies as pathways into creativity. *ZDM – Mathematics Education*, *49*(1), 137–145. https://doi.org/10.1007/s11858-016-0822-8

Subanji, Nusantara, T., & Rahmatina, D. (2021). Kerangka kerja kreatif statistik dalam aktivitas statistik deskriptif. *Jurnal Pembelajaran Internasional*, *14*(2), 591–608. https://doi.org/10.29333/iji.2021.14233a

Zamzam, K. F., Agustin, R. D., Rosyadi, A. A., & Walida, S. E. (2026). Teacher's Creative Model for Developing Child- Friendly Digital-Based Assignments in Indonesian Junior High Schools. *International Journal of Learning, Teaching and Educational Research*, *25*(1), 111–134. https://doi.org/10.26803/ijlter.25.1.6

Zamzam, K. F., Sa'dijah, C., Subanji, & Rahardi, R. (2023). *The Creative Thinking Process of Prospective Teachers in Developing Assignments*. *23*(1), 101–108. https://doi.org/10.33423/jhetp.v23i1.5793

Zamzam, K. F., & Wijayanti, R. (2022). Karakteristik Tingkat Kreativitas mahasiswa Calon Guru dalam Memodifikasi Tugas Matematika Ditinjau dari Gaya Belajar. *Laplace: Jurnal Pendidikan Matematika,* *5*(1), 129–139. https://doi.org/10.31537/laplace.v5i1.676