

The Creativity of Pre-Service Mathematics Teachers in Digital Learning

Venissa Dian Mawarsari^{1,a)}, Andari Puji Astuti^{1,b)}, Hindriyanto Dwi Purnomo^{2,c)}, Eko Sedyono^{2,d)}, Eko Andy Purnomo^{1,e)}

¹Universitas Muhammadiyah Semarang, Jl. Kedungmundu Raya No 18, Semarang

²Universitas Kristen Satya Wacana, Jl. Kartini No 11A, Salatiga

e-mail: ^{a)}venissa@unimus.ac.id, ^{b)}andari@unimus.ac.id, ^{c)}hindriyanto.purnomo@staff.uksw.edu,
^{d)}eko@staff.uksw.edu, ^{e)}ekoandy@unimus.ac.id

Abstract

Implementing teaching assistants for students of the Education Study Program in schools during distance learning makes them have to be creative in using technology in learning. So the purpose of this research is to find out the forms of creativity of pre-service teachers who use technology in distance learning during the COVID-19 pandemic. This study uses a qualitative method with a case study approach to Mathematics Education students at a private Islamic university in Semarang, Indonesia who carry out teaching assistance at partner schools. The data collection used in this research is observation and interviews. According to the results obtained, the creativity of prospective mathematics teachers in applying learning media is shown in making learning videos, interactive multimedia, and presentation materials using PowerPoint (PPT) containing material and sample questions. Second, creativity in utilizing the potential of schools is the use of online learning platforms, including Microsoft Teams, Zoom meeting, Learning Management System (e-learning), Google Classroom, Google Meet, and WhatsApp Groups. Creativity in designing learning that can foster creativity and innovation for students includes developing lesson plans that utilize the platforms and media created and applying learning approaches such as constructivism and contextual. In addition, it also applies game learning strategies and group discussions through breakout rooms.

Keywords: videos, interactive multimedia, learning management system, microsoft teams

INTRODUCTION

Digital learning is a learning process that utilizes information and communication technology (Lin et al., 2017; Tvenge & Martinsen, 2018), which can be done in synchronous or asynchronous learning (Purnama, 2020). The rapid development of technology has undoubtedly affected the world of education (Raja & Nagasubramani, 2018). Especially Human Resources in education, namely teachers who must master technological developments (Laksono & Program, 2021), including mathematics teachers. A mathematics teacher must be ready to face changes according to technological developments and create learning conditions for students who can develop their 4C skills

(Murdiana et al., 2020; Tvenge & Martinsen, 2018). Pre-service mathematics teachers must be prepared to master technology in learning (Mawarsari et al., 2020).

Mathematics education students who are pre-service teachers should participate in school teaching practices as assistant teachers. One of the obligations of pre-service teachers is to work with teachers to design mathematics lessons (Isnawan & Wicaksono, 2018) in the form of a learning plan that contains media, learning methods/strategies, assessments, and rubrics for cognitive, affective, and psychomotor assessments (Oviana, 2018). Online learning implemented by partner schools during the COVID-19 pandemic requires pre-service teachers to innovate and

be creative in creating fun learning, and learning objectives are met by utilizing technology (Afghani, 2020).

Creativity is the ability to solve problems in new, rare, and unique ways (Southern et al., 2020). Teacher creativity in the learning process can be seen from various points of view, namely from learning methods/strategies, designing the classroom atmosphere, and learning media (Southern et al., 2020). Pre-service teachers must also have creativity in learning. Mathematics is a subject that exists at every level of education. Students often have difficulty with certain materials, especially with distance learning with a limited duration of face-to-face hours. One of the obstacles faced during online learning is to grow and create the creativity of pre-service teachers in the teaching and learning process (Southern et al., 2020).

This study aimed to determine the creativity of prospective mathematics teachers in mastering technology during teaching practices at partner schools during the COVID-19 pandemic. This research can determine how far the students' abilities are in dealing with distance learning situations and their compatibility with partner schools where prospective teachers practice teaching so that the results of this study can later be used to evaluate the curriculum of the Mathematics Education department, which will produce graduates as pre-service teachers who are in accordance with the needs of the community and master technological developments in learning.

METHODS

This study uses a qualitative method with a case study approach. The subjects of this study were students of Mathematics Education at a Private Islamic University in Semarang, Indonesia who were carrying out

teaching practices at partner schools. There are 4 (four) partner schools, so the creativity of pre-service mathematics teachers is distinguished from the four schools. The determination of the subject of this research must meet the inclusion criteria, namely: (1) there are mathematics education students who are carrying out teaching practices in schools, (2) students are allowed by partner schools to teach in mathematics classes, and (3) students are already teaching in class at least three times. The exclusion criteria in this study were students who were not willing to be research subjects.

Data were collected through observation and interviews. Observations were made when pre-service teachers were practicing in class. Interview data were conducted on pre-service teachers and students who had studied with prospective mathematics teachers. The interview data analysis technique used is inductive coding and described descriptively. The creativity indicator used in this study refers to Muchsolehudin (Relisa et al., 2019), namely: 1) Apply innovative and fun mathematics learning using appropriate tools, media, and learning resources (indicator 1), consists of 4 (four) questions; 2) Optimizes the learning process by utilizing the school's potential and establishing a creative and innovative learning process that can adapt to various situations (indicator 2), consists of 3 (three) questions; 3) Lesson plans can foster creativity and learning innovation for students (indicator 3), consists of 3 (three) questions.

RESULTS AND DISCUSSION

The results showed that the research subjects were mathematics education students who carried out teaching practices at partner schools A, B, C, and D. The following are the observations and interviews. Table 1 present the research results for Indicator I.

Table 1. Research Results for Indicator 1

Subject	Research result
School A	
SA	The majority of the learning media used in delivering the material are PowerPoint media (PPT). PPT media contains material, sample questions, and practice questions. It also includes short games to motivate students in learning mathematics, such as guessing pictures and guessing words. Other media used is interactive multimedia, which contains material, sample questions, and practice questions that students can answer interactively in distance learning. Learning media is made by prospective teachers using Macromedia Flash or SWiSH Max software.
School B	
SB	The media that is often used in the learning process is in the form of learning videos containing material and sample questions. This is due to the limited time in distance learning. So pre-service mathematics teachers innovate to make videos based on tutors' suggestions. Videos made based on guidance by the tutor teacher are then shared with students so that they can study the material independently. The videos produced are the results of pre-service teachers using the Powtoon and PowerPoint (PPT). This media is also used in several face-to-face meetings virtually.
School C	
SC	The learning media made by pre-service teachers is to make teaching videos directly using the blackboard in explaining the material or giving examples of questions. The learning video is made, and then the link is shared with students via Group Messenger.
School D	
SD	The learning media used by pre-service mathematics teachers is to make learning videos in the delivery of material which is then shared with the video link to students via Google Classroom or Group Massager for Mathematics. Pre-service teachers produce videos with the help of PPT and use Powtoon. The duration of the videos made is around 10-18 minutes.

Based on the research results in Table 1, prospective mathematics teachers' creativity in learning is the use of technology-based learning media, such as learning videos and interactive multimedia, and the learning media created is assisted by applications or software that pre-service teachers control. The existence of applications or software can support learning activities during the pandemic (Ningrum et al., 2020). Applications used include Macromedia Flash, Powtoon, PowerPoint, Kinemaster.

The use of technology-based learning media is, of course, adapted to the needs of students in online learning (Southern et al., 2020; Afghani, 2020). Mathematical material that requires a variety of symbols, graphics,

and images is certainly a consideration for pre-service teachers in making learning media that utilizes technology (Rahadyan et al., 2018). Learning videos containing material are beneficial for students during online learning (Munadhiroh & Mawarsari, 2020). Learning media made by prospective mathematics teachers contains material, sample questions, and discussions accompanied by attractive animated visuals, audio and flexible music instruments played by students to change students' learning styles to become independent (Agustinaningsih, 2020).

The results of the second research indicator of the creativity of pre-service mathematics teachers in digital learning are obtained in the Table 2.

Table 2. Research Result for Indicator 2

Subject	Research result
School A	<p>SA Microsoft Teams is the mandatory platform used in online learning at partner school A, so that in learning mathematics teacher candidates, Microsoft Teams by partner schools. This platform uses synchronous learning directly, with activities almost the same as synchronous in class during offline learning. Namely, there are opening activities (checking students' readiness to learn), core activities (delivery of material, sample questions, and practice questions), and closing activities (conclusions and assignments at home). In learning to use Microsoft Teams, the team is still not familiar with its use. Students are still fumbling for the features available on Microsoft Teams. They often use Zoom meeting or Google Meet during microteaching on campus. However, after more than three times of learning using Microsoft Teams, pre-service mathematics teachers can already use it easily.</p>
School B	<p>SB The mandatory platform used in online learning at partner school B is Microsoft Teams. Pre-service teachers had difficulties initially, but they could easily use Microsoft Teams after three lessons. In school B, the lesson hours are shortened so that activities take place more quickly. The creativity of pre-service mathematics teachers is to make learning videos whose links are sent before synchronous learning takes place for students to study independently. So that in class, it is more on material conclusions and practice questions. Another platform used is WhatsApp Group (WAG), which usually notified to share learning video links and discussions.</p>
School C	<p>SC The mandatory platform used in school C is the Learning Management System (LMS) in the form of the school's e-learning. E-learning contains online classes with student materials and assignments and includes student attendance in every lesson and teacher attendance, which the vice-principal or principal can monitor. However, you can use Zoom meeting or Google Meet to interact with pre-service mathematics teacher students who have creativity by using other platforms for synchronous learning online. Pre-service teachers do this to emphasize the problematic material for students to understand. The evaluation results if only using the LMS; many students did not understand the material presented by only providing material on the PPT and assignments in the LMS. In addition, sometimes pre-service teachers make short videos explaining material that is shared via LMS or WAG links.</p>
School D	<p>SD There is no mandatory platform used by school D. The school exempts teachers or pre-service teachers from using online learning platforms. The results of observations of pre-service mathematics teachers at the beginning of practice at school showed most students have difficulties and objects if every synchronous uses virtual meetings; this is due to signal problems and also challenges in procuring internet quotas. So the creativity that pre-service teachers carry out is to create an LMS through the Google Classroom platform for delivering material and collecting assignments to make it more accessible to active and inactive students. Another creativity is that pre-service teachers make videos shared through Google Classroom and WAG. WAG is also actively used for question-and-answer discussions.</p>

Based on the results of the research in Table 2, regarding the utilization of school potential and the setting of creative and innovative learning processes capable of adapting to various situations, it was found that pre-service teachers mastered the platform used by partner schools both using Microsoft Teams, e-learning, Zoom meeting, Google

Classroom, Google Meet and WAG. Pre-service mathematics teachers took the initiative to use virtual learning meetings to help students understand the material (Raja & Nagasubramani, 2018) and allow students to study anywhere remotely (Assidiqi & Sumarni, 2020). The creativity of pre-service teachers in utilizing virtual meetings is one of the abilities

to use the technology needed in the digital era (Tvenge & Martinsen, 2018), thereby creating a different learning atmosphere and increasing students' ability to use technology-based learning media (Figg et al., 2020).

The last research indicators of creativity of pre-service mathematics teachers in digital learning are obtained in the Table 3. Based on the research results in Table 3, regarding learning designs that can foster creativity and learning innovation for students, it is found that online learning can still implement various methods, approaches, and learning strategies carried out during offline learning. Understanding that can be done includes a constructivist approach. Pre-service teachers carry out the constructivism approach in interactive multimedia made through productive questions that help students construct their thinking to find concepts (Akpan et al., 2020) and solve problems (Jia, 2010). Applying a constructivist approach to

online learning shows an excellent interactive process (Budyastuti & Fauziati, 2021).

The contextual media approach made in online learning can also be appropriately applied. Hence, students know the usefulness of the material learned in everyday life (Lotulung et al., 2018) and are motivated to learn mathematics (Ilyas & Liu, 2020). Cooperative learning models in the form of discussions can also be applied during online learning through platforms, such as breakout rooms at Zoom meetings, forming discussion groups in Google Classroom, and WAG (Prihaswati et al., 2020). This discussion of cooperative learning can certainly activate students during the learning process (Blackmon, 2012). The creativity of pre-service teachers in online education is undoubtedly designed based on evaluations and discussions with supervising teachers at each partner school.

Table 3. Research Result for Indicator 3

Subject	Research result
School A	
SA	The creativity of learning designs designed by pre-service teachers at school A is a constructivist approach, namely interactive multimedia made by pre-service teachers in formulating mathematical concepts using constructivism stages so that students can construct their thoughts in solving the following problem. In addition, contextual learning is also applied, where each video made is associated with daily issues, and practice questions are also related to contextual problem-solving. The learning strategy used is games. These games include guessing words, guessing pictures, and online tournament games.
School B	
SB	Pre-service mathematics teachers' creativity of learning designs at school B uses virtual meeting platforms and group discussions conducted through Microsoft Teams or WAG. In addition, the videos made are also associated with contextual problems so that students better understand the importance of the material.
School C	
SC	The creativity of learning design for pre-service mathematics teachers at school C applies group discussion learning, conducted virtually through zoom meetings in breakout rooms sessions. Pre-service teachers can enter or check the discussion directly by taking turns in each room. Then in the presentation session, each group presents the results of their discussion to other groups.
School D	
SD	The creativity of learning design for pre-service mathematics teachers at school D is the application of cooperative learning through Google Classroom. Each group discusses through Google Classroom, which pre-service teachers can monitor. Then, at the stage of presenting the discussion results, each group is asked to make a video presentation.

CONCLUSION

This research concludes that pre-service teachers have prepared themselves in teaching practice at partner schools for online learning. The existence of micro-teaching for prospective teachers who apply various virtual meeting platforms and media creation can practice their technology skills. This creativity will be honed and increased after pre-service teachers conduct classroom learning at partner schools. This creativity is adapted to existing policies in partner schools so that the form of the invention of pre-service teachers in each partner school will be different from one another.

According to the results obtained, the creativity of prospective mathematics teachers in applying learning media is shown in making learning videos, interactive multimedia, and presentation materials using PowerPoint (PPT) containing material and sample questions. Second, creativity in utilizing the potential of schools is the use of online learning platforms, including Microsoft Teams, Zoom meeting, Learning Management System (e-learning), Google Classroom, Google Meet, and WhatsApp Groups. Creativity in designing learning that can foster creativity and innovation for students includes developing lesson plans that utilize the platforms and media created and applying learning approaches such as constructivism and contextual. In addition, it also applies game learning strategies and group discussions through breakout rooms.

REFERENCE

- Afghani, D. R. (2020). Kreativitas pembelajaran daring untuk pelajar sekolah menengah dalam pandemi Covid-19. *Journal of Informatics and Vocational Education*, 3(2), 70–75. <https://doi.org/10.20961/joive.v3i3.43057>
- Agustinaningsih, W. (2020). Profil kreativitas calon guru fisika dengan manajemen pembelajaran berbasis gaya belajar. *Jurnal Pendidikan Fisika*, 8(1), 112-125. <https://doi.org/10.24127/jpf.v8i1.2601>
- Akpan, V. I., Igwe, U. A., Mpamah, I. B. I., & Okoro, C. O. (2020). Social constructivism: implications on teaching and learning. *British Journal of Education*, 8(8), 49–56. <https://www.eajournals.org/wp-content/uploads/Social-Constructivism.pdf>
- Assidiqi, M. H., & Sumarni, W. (2020). Pemanfaatan platform digital di masa pandemi covid-19. *Prosiding Seminar Nasional Pascasarjana*, 298–303. <https://proceeding.unnes.ac.id/index.php/snpasca/article/download/601/519>
- Blackmon, S. J. (2012). Outcomes of chat and discussion board use in online learning: A research synthesis. *Journal of Educators Online*, 9(2), 1-19. <https://doi.org/10.9743/JEO.2012.2.4>
- Budyastuti, Y., & Fauziati, E. (2021). Penerapan teori konstruktivisme pada pembelajaran daring interaktif. *Jurnal Papeda: Jurnal Publikasi Pendidikan Dasar*, 3(2), 112–119. <https://doi.org/10.36232/jurnalpendidikan.dasar.v3i2.1126>
- Figg, C., Khirwadkar, A., & Welbourn, S. (2020). Making 'math making' virtual. *Brock Education Journal*, 29(2), 30-36. <https://doi.org/10.26522/brocked.v29i2.836>
- Ilyas, I., & Liu, A. N. A. M. (2020). The effect of based e-learning contextual approach on student learning motivation. *Jurnal Penelitian Pendidikan IPA*, 6(2), 184-189. <https://doi.org/10.29303/jppipa.v6i2.425>
- Isnawan, M. G., & Wicaksono, A. B. (2018). Model Desain pembelajaran matematika. *Indonesian Journal of Mathematics Education*, 1(1), 47-52. <https://doi.org/10.31002/ijome.v1i1.935>
- Jia, Q. (2010). A brief study on the implication of constructivism teaching theory on classroom teaching reform in basic education. *International Education Studies*, 3(2), 197–199.

- <https://doi.org/10.5539/ies.v3n2p197>
- Laksono, P. J., & Program. (2021). Literasi digital calon guru sains di universitas Islam pada masa pandemi Covid-19. *Orbital: Jurnal Pendidikan Kimia*, 5(1), 1–12.
<https://doi.org/10.19109/ojpk.v5i2.10301>
- Lin, M. H., Chen, H. C., & Liu, K. S. (2017). A study of the effects of digital learning on learning motivation and learning outcome. *Eurasia Journal of Mathematics, Science and Technology Education*, 13(7), 3553–3564.
<https://doi.org/10.12973/eurasia.2017.00744a>
- Lotulung, C. F., Ibrahim, N., & Tumurang, H. (2018). Effectiveness of learning method contextual teaching learning (CTL) for increasing learning outcomes of entrepreneurship education. *Turkish Online Journal of Educational Technology - TOJET*, 17(3), 37–46.
<https://files.eric.ed.gov/fulltext/EJ1184198.pdf>
- Mawarsari, V. D., Astuti, A. P., Purnomo, H., & Sedyono, E. (2020). The readiness of prospective mathematics teachers in utilizing technology in the 21st century learning process. *Proceedings of the 2nd International Conference on Education*, 481–491. <https://doi.org/10.4108/eai.28-9-2019.2291090>
- Munadhiroh, N., & Mawarsari, V. D. (2020). Penerapan lesson study pembelajaran matematika menggunakan video pendekatan student center learning terhadap motivasi dan hasil belajar. *Edusaintek*, 108–118.
<https://prosiding.unimus.ac.id/index.php/edusaintek/article/view/550>
- Murdiana, Jumri, R., & Damara, B. E. P. (2020). Pengembangan kreativitas guru dalam pembelajaran kreatif. *Jurnal Pendidikan Matematika Raflesia*, 5(2), 153–160.
<https://doi.org/10.33369/jpmr.v5i2.11450>
- Ningrum, M., Hidayati, D., Pendidikan, M. M., & Dahlan, U. A. (2020). Pemilihan software sebagai media ajar selama masa COVID-19 di Universitas Ahmad Dahlan. *Jurnal Administrasi Pendidikan*, 27(2), 213–217.
- Oviana, W. (2018). Pengembangan rencana pelaksanaan pembelajaran berbasis pendekatan saintifik oleh guru SD dan MI di Kota Sabang. *PIONIR: Jurnal Pendidikan*, 7(1), 1–16.
<https://doi.org/10.22373/pjp.v7i1.3316>
- Prihaswati, M., Mawarsari, V. D., & Winaryati, E. (2020). Applying google classroom based on prospective teacher. *Journal of Physics: Conference Series*, 1446(1). <https://doi.org/10.1088/1742-6596/1446/1/012050>
- Purnama, M. N. A. (2020). Blended learning sebagai sarana optimalisasi pembelajaran daring di era new normal. *SCAFFOLDING: Jurnal Pendidikan Islam Dan Multikulturalisme*, 2(02), 106–121.
<https://doi.org/10.37680/scaffolding.v2i02.535>
- Rahadyan, A., Hartuti, P. M., & Awaludin, A. A. R. (2018). Penggunaan aplikasi geogebra dalam pembelajaran matematika di sekolah menengah pertama. *Jurnal PkM Pengabdian Kepada Masyarakat*, 1(01), 11.
<https://doi.org/10.30998/jurnalpkm.v1i01.2356>
- Raja, R., & Nagasubramani, R. R. P. C. (2018). Impact of modern technology in education. *Journal of Applied and Advanced Research*, 3(1), 33–35.
<https://doi.org/10.21839/jaar.2018.v3iS1.165>
- Relisa, R., Murdiyaningrum, Y., & Lismaynati, S. (2019). *Kreativitas guru dalam implementasi kurikulum 2013*. Pusat Penelitian Kebijakan Pendidikan dan Kebudayaan, Jakarta.
<http://repositori.kemdikbud.go.id/18105/>
- Southern, A., Elliott, J., & Morley, C. (2020). Third space creative pedagogies: Developing a model of shared CPDL for

teachers and artists to support reading and writing in the primary curricula of England and Wales. *International Journal of Education and Literacy Studies*, 8(1), 24-31. <http://www.journals.aiac.org.au/index.php/IJELS/article/view/5822/4161>

Tvenge, N., & Martinsen, K. (2018). Integration of digital learning in industry 4.0. *Procedia Manufacturing*, 23(2017), 261–266. <https://doi.org/10.1016/j.promfg.2018.04.027>