

Improving Students' Math Writing Skills and Interest Through Online-Based Flipped Classroom Models

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Abstract. In today's advanced technological era, the online-based flipped classroom learning model can overcome online learning problems while improving students' mathematical writing skills and interest in learning. The study aims to improve students' mathematical writing skills and interest in learning with an online-based flipped classroom learning model. The type of research is classroom action research (PTK) with a posttest only one group design. The research subjects were 38 students majoring in mathematics education at Bina Bangsa University for the 2019-2020 academic year in the even semester. There are four stages of PTK which are carried out in several cycles, namely the planning stage, implementing actions, observation, and reflection. From the results of this study, it was concluded that the online-based flipped classroom model is effective in improving students' mathematical writing skills. Furthermore, it is concluded that students' learning experiences after being given learning with an online-based flipped classroom model, the majority of which are classified as high.

Keywords: *Math Writing; Interest; Flipped Classroom.*

Abstrak. Di era teknologi yang semakin maju saat ini, model pembelajaran flipped classroom berbasis online dapat mengatasi permasalahan pembelajaran online sekaligus meningkatkan kemampuan menulis matematis dan minat belajar siswa. Penelitian ini bertujuan untuk meningkatkan keterampilan menulis matematis dan minat belajar siswa dengan model pembelajaran flipped classroom berbasis online. Jenis penelitian ini adalah penelitian tindakan kelas (PTK) dengan desain posttest only one group design. Subyek penelitian adalah 38 mahasiswa jurusan pendidikan matematika Universitas Bina Bangsa tahun ajaran 2019-2020 semester genap. Ada empat tahapan PTK yang dilakukan dalam beberapa siklus, yaitu tahap perencanaan, pelaksanaan tindakan, observasi, dan refleksi. Dari hasil penelitian ini disimpulkan bahwa model flipped classroom berbasis online efektif dalam meningkatkan kemampuan menulis matematis siswa. Selanjutnya disimpulkan bahwa pengalaman belajar siswa setelah diberikan pembelajaran dengan model flipped classroom berbasis online mayoritas tergolong tinggi.

Kata Kunci: *Menulis Matematika; Minat; Kelas Terbalik.*

A. **Pendahuluan**

Online learning is not a new thing anymore in this era of 2022. Many schools are currently deciding to continue using online learning to overcome the spread of Covid-19. At the beginning of the spread of Covid-19, all levels of education, from elementary schools to universities, are required to conduct online learning (Naserly, 2020). The Minister of Education and Culture of Indonesia, Nadiem Makarim, also said that the existence of online learning rules during the Covid-19 period requires the world of education, both students and teachers, to continue to explore their abilities in learning technology.

The era of 2022 is the internet era, which means that the internet is an important part and cannot be separated from people's lives. Based on the results of previous studies, it is known that students still use technology, not for learning, due to the lack of demands from both the school and parents (Wayan Iliya Yuda Sukmana & Kadek Suartama, 2018). Furthermore, according to (Tsai et al., 2018), it is necessary to provide gradual information to students and teachers to be aware of optimally utilizing technology in learning.

Furthermore, judging from the student learning outcomes, it is known that education in Indonesia is still relatively low compared to other Southeast Asian countries, namely judging from the results of TIMSS or PISA (Fauziah, 2015). Permendiknas Number 20 of 2006 Content Standards are written about one of the objectives in learning mathematics in schools so that students have mathematical communication skills Fauziah (2015). Alluding to mathematical communication skills, namely a person's ability to convey ideas using mathematical symbols and numbers with clear writing rules.

According to Baroody, there are five components in communication activities: representation (representing), listening, reading, discussing, and writing (Ramadhani et al., 2021). Mathematical writing is an activity that is inseparable from the learning of mathematics and is of great importance as a tool for the metacognitive development of a person Knox (2017). A person who can do operations in mathematics with internal representations, and then to get the ability to solve mathematical problems up to that level, is inseparable from mathematical writing activities.

Mathematical writing is considered quite difficult for most students. This is in line with the results of previous studies, which showed that students' mathematical writing skills are still low. (Fauziah, 2015), (Accurso, 2017), dan (Agustiani et al., 2018). The low writing ability of students is influenced by many factors, one of which is the interest of students to carry out these writing activities in particular and generally the interest of students in following the learning process in class. Based on the study's results (Kusuma & Hamidah, 2019) it is known that the learning model used dramatically influences the student's learning interest in getting involved during the learning process. Furthermore, interest in learning significantly affects learning outcomes, especially students' interest in doing writing activities.

Departing from these problems, the learning process significantly influences students' ability to write mathematically and students' interest in carrying out writing activities during the learning process in class. So it needs the right learning model to overcome this. One suitable model is the flipped classroom learning model. According to (Wayan Iliya Yuda Sukmana & Kadek Suartama, 2018) and (Elmaadaway, 2018) flipped classroom learning model, a learning process whose teaching strategy is to reduce direct commands but prioritise interaction with each other. According to (Vermana & Zuzano, 2018) and (Mirlanda et al., 2020) flipped classroom learning leads students to study, read books and look for references at home before classroom learning begins.

In today's advanced technological era, an online-based flipped classroom learning model was chosen to overcome online learning problems while improving students' mathematical writing skills and interest in learning. In this case, the learning process leads students to make small notes around the material before learning so that students get used to writing mathematically. Students' interest in learning will also increase because before learning, students already have material provisions to make students more confident and willing to continue to be involved in the learning process.

This study aims to improve students' mathematical writing skills and learning interests

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with an online-based flipped classroom learning model.

The formulation of the problem in this study is:

1. Is the online-based flipped classroom model effectively improving students' mathematical writing skills?
2. What is the student's interest in learning after being given learning with an online-based flipped classroom model?

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B. Metodologi Penelitian

The type of research is classroom action research (PTK) with a posttest only one group design. The research population is students majoring in mathematics education at Bina Bangsa University for the 2019-2020 academic year in the even semester. There were 38 students sampled in this study who took part in the analytical geometry course. There are four stages of PTK which are carried out in several cycles, namely the planning stage, implementing actions, observation, and reflection.

The planning stage is to carry out the preparation of teaching materials for cone slice material. The implementation stage is to conduct learning with an online-based flipped classroom model via zoom. Before the learning process, students are given learning videos about the material and simulations with mathematics software about cone slices and Youtube links about the material. In the learning video, there are practice questions that students must do at home, so that when the learning starts, there will be a lot of material to discuss. The observation stage is to observe the learning process by filling out an observation sheet. The reflection stage analyses the observations' results and evaluates the learning process. If the results of the analysis and observation of the learning process are still not up to the target of the reflection stage, this also makes evaluation points an improvement for the next cycle.

Instruments for collecting data are questionnaires of learning interests and tests of student writing ability made based on their indicators. Questionnaires and tests have been tested and validated by experts before so that they have been declared valid and suitable for use. The data analysis technique of the students' math writing skills result in this study is to determine the percentage of classical completion of students who have a C+ equivalent grade (grade 65 on a scale of 100) upwards on the quiz of each cycle calculated by using the following formula (Yuliawati, 2019):

$$\text{Percentage} = \frac{\text{Number of Students With Grades Above 65}}{\text{Total Students}} \times 100\%$$

The percentage of classical completion for students' math writing skills in space geometry courses is $\geq 85\%$ of students achieve grades above 65.

Students' mathematics interest is analyzed by being classified in the categorization table. Study interest poll scores range from 30 to 150. To determine the criteria for measurement results are classified based on average, namely:

$$\left(\bar{x} = \frac{30+150}{2} = 90 \right)$$

And deviation

$$\left(s = \frac{150-30}{6} = 20 \right).$$

The following table shows categorizing using criteria.

Table 1. Learning Interest Qualifications

Score Interval	Score	Category
$X > \bar{x} + 1,5s$	$X > 120$	Very high
$\bar{x} + s < X \leq \bar{x} + 1,5s$	$100 < X \leq 120$	High
$\bar{x} - 0,5s < X \leq \bar{x} + s$	$80 < X \leq 100$	Enough
$\bar{x} - 1,5s < X \leq \bar{x} - 0,5s$	$60 < X \leq 80$	Low
$X \leq \bar{x} - 1,5s$	$X \leq 60$	Very Low

The resulting data of the student's study interest category has then calculated the percentage of classical completion, that is students who have a high or very high learning interest after being given learning calculated by using the following formula (Yuliawati, 2019):

$$\text{Percentage} = \frac{\text{Number of Students with high interest categories and very high}}{\text{Total Students}} \times 100\%$$

The percentage of classical completion for student learning interests is $\geq 80\%$ of students have a high and very high learning interest after learning.

C. Hasil Penelitian dan Pembahasan

The results of this study obtained two cycles, namely in cycle two, they have obtained effective results on mathematical writing ability and student interest in learning. Each cycle is carried out with three meetings according to the existing course schedule. The results of the student writing ability test from each cycle are as follows:

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Table 2. Students' Math Writing Skills Results Cycle I and II

Descriptive Statistics

	N	Min	Max	Mean	SD	Var
Cycle I	38	51	78	65.87	6.85	46.87
cycle	38	63	85	73.71	6.96	48.43
Valid N (listwise)	38					

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Table 2 shows that in the second cycle students have shown an average result of good mathematical writing ability, above 65. This is because the online-based flipped classroom learning model can train students' writing skills with a learning process that leads students to often take small notes before learning begins. According to previous research, it is also known that the flipped classroom model can improve students' mathematical thinking skills (Mirlanda et al., 2020). According to Vermana & Zuzano (2018) learning process with flipped classroom model there is a strategy that gives students problems to be solved first with discussion. This discussion process indirectly trains students to argue and write down their arguments.

Next is the result of processing data on student learning interest questionnaires after being given learning with an online-based flipped classroom model.

Table 3. Student Learning Interests

Learning Interest Criteria	Percentage (%)				Total
	Feelings of pleasure	Attention	Interest	Student engagement	
Very high	5	3	1	4	13
High	17.5	19	21	24	81.5
Enough	2	1	1.5	1	5.5
Low	0	0	0	0	0

Table 3 shows that most students' interest in learning is relatively high. Students admitted that the breadth in finding information on YouTube references and others provides comfort in learning. Students also stated that the learning model is interesting because of the animation of the material to be understood before learning. According to (Cheng et al., 2019) Learning strategies that ensure students learn the material before learning begins are very influential in improving students' ability to understand the material.

The strategy used in the learning process with an online-based flipped classroom model is to provide material before learning and direct students to make small notes in the form of writing, either material or solving practice questions given. According to K.C. & Ghimire (2020) and Guce (2017) Writing activities are one of the many ways that are considered good in directing someone to understand the material being taught and inviting students to be directly involved in learning. According to Özcan & Eren Gümüş (2019) with the self-confidence that students have will give rise to a consistent interest in learning for students throughout the learning process. This is also supported by the statement Hari *et al.* (2018) that a person's interest in learning that arises out of confidence in one's ability to fight is shown by the way he presents arguments both asking and debunking questions in discussion forums. So that this of course, in addition to affecting students' interest in learning, also affects their ability to understand the material being delivered.

In addition, the learning process carried out is via zoom or online. Online learning is an interesting learning process for students because students can use technology widely. Briefings from lecturers are very important at this time to anticipate students looking for references outside the material being discussed. One way is to keep mentioning the student's name every time about what is being discussed. This contributes to taking the attention of students to stay focused on participating in learning. This is in line with the opinion (Wong et al., 2019) that technology has a very positive effect on a person's abilities but must be supervised.

In the learning process there are two cycles, in the first cycle it was found that many students were less involved in discussions and questions and answers. Students also stated that it is necessary to deliver more material from lecturers. This is because students are lazy to read at home and think the material must be obtained only from the lecturer. So that in the next cycle, students are instilled with an understanding that the source of knowledge should not only be from lecturers and that students have an obligation to explore their knowledge and curiosity online.

Furthermore, in cycle two, the obstacles in cycle one are overcome by providing learning videos in the form of animations from mathematics applications and Youtube links about the material. As stated by Ayçiçek & Yelken (2018) that one of the strategies of the flipped classroom learning model is to provide learning videos. Students are also welcome to discuss via wa group if there are any obstacles in solving the problem. The next step for students is also conveyed that students' activeness in asking and discussing before and after learning will be assessed in detail.

The findings in the second cycle are that students are very enthusiastic about discussing and very communicative in the question and answer process. Based on the results of the study

Sukmana & Stuartama (2018) it is also known that flipped classroom learning is able to activate students in finding their own teaching materials. Further according to (Akçayır & Akçayır, 2018) flipped classroom learning indirectly invites students to continue to be involved in learning so that it has a good impact in developing students' ability to understand the teaching material.

Furthermore, the results of student work in writing mathematics are presented, namely solving the given problems.



Fig. 1. Answer Sheet

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Mathematical writing ability is a communication activity to express ideas, understanding, and misconceptions related to mathematics to others using the right mathematical language. Figure 1 shows that students are able to show their writing skills in solving math problems. The ability to write mahastudents is shown by the way students express their ideas in understanding math problems and solving problems using the right mathematical language. It is also in accordance with the opinion Astuti (2018) which states that the ability to write mathematically is something that uses activities in writing and the experience of learning mathematics.

D. Kesimpulan

From the results of this study, it was concluded that the online-based flipped classroom model is effective in improving students' mathematical writing skills. Furthermore, it was concluded that students' learning experiences after being given learning with an online-based flipped classroom model are mostly relatively high.

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Daftar Pustaka

- [1] Accurso, K. M. S. (2017). Analyzing Diverse Learners' Writing in Mathematics: Systemic Functional Linguistics in Secondary Pre-Service Teacher Education. *International Journal for Mathematics Teaching and Learning*, 18(1), 84–108. http://www.academia.edu/download/53134867/Accurso_Gebhard_Purington_2017_-_SFL_and_math_writing_feedback.pdf
- [2] Agustiani, R., Hartatiana, H., & Wardani, A. K. (2018). Mathematics students' writing skills: Assesment in higher education with Rasch model. *International Journal on Teaching and Learning Mathematics*, 1(2), 90–102. <https://doi.org/10.18860/ijtlm.v1i2.6749>
- [3] Akçayır, G., & Akçayır, M. (2018). The flipped classroom: A review of its advantages and challenges. *Computers and Education*, 126(August), 334–345. <https://doi.org/10.1016/j.compedu.2018.07.021>

Commented [U8]: There is a language error. Please cite several articles from reputable international journals.

- [4] Astuti, N. Ek. (2018). ANALISIS KEMAMPUAN MENULIS MATEMATIS SISWA DITINJAU DARI GAYA BELAJAR KOLB PADA PEMBELAJARAN MATEMATIKA MODEL THINK TALK WRITE (Issue 024).
- [5] Ayçiçek, B., & Yelken, T. Y. (2018). The effect of flipped classroom model on students' classroom engagement in teaching english. *International Journal of Instruction*, 11(2), 385–398. <https://doi.org/10.12973/iji.2018.11226a>
- [6] Cheng, L., Ritzhaupt, A. D., & Antonenko, P. (2019). Effects of the flipped classroom instructional strategy on students' learning outcomes: a meta-analysis. In *Educational Technology Research and Development* (Vol. 67, Issue 4). Springer US. <https://doi.org/10.1007/s11423-018-9633-7>
- [7] Elmaadaway, M. A. N. (2018). The effects of a flipped classroom approach on class engagement and skill performance in a Blackboard course. *British Journal of Educational Technology*, 49(3), 479–491. <https://doi.org/10.1111/bjet.12553>
- [8] Fauziah, S. (2015). UPAYA MENINGKATKAN KEMAMPUAN MENULIS MATEMATIS MELALUI PENDEKATAN MATEMATIKA REALISTIK.
- [9] Guce, I. K. (2017). Mathematical Writing Errors in Expository Writings of College Mathematics Students. *International Journal of Evaluation and Research in Education (IJERE)*, 6(3), 233. <https://doi.org/10.11591/ijere.v6i3.8549>
- [10] Hari, L. V., Zanthly, L. S., & Hendriana, H. (2018). Hasil analisis menunjukkan bahwa terdapat hubungan yang signifikan antara self-efficacy siswa dengan kemampuan berpikir kritis matematis siswa dan pengaruh self- efficacy terhadap kemampuan berpikir kritis siswa SMK kelas XI negatif yaitu sebesar 19,89% s. *Jurnal Pembelajaran Matematika Inovatif*, 1(3), 435–444. <https://doi.org/10.22460/jpmi.v1i3.435-444>
- [11] K.C., D. J., & Ghimire, S. (2020). Basics and Structure of Project Writing in Mathematics. *Journal of Nepal Mathematical Society*, 3(1), 21–30. <https://doi.org/10.3126/jnms.v3i1.33000>
- [12] Knox, H. (2017). Using Writing Strategies in Math to Increase Metacognitive Skills for the Gifted Learner. *Gifted Child Today*, 40(1), 43–47. <https://doi.org/10.1177/1076217516675904>
- [13] Kusuma, J. W., & Hamidah. (2019). Pengaruh Model Pembelajaran ARIAS Dan Cooperative Script Terhadap Minat Dan Hasil Belajar Matematika. *ANARGYA: Jurnal Ilmiah Pendidikan Matematika*, 2(1), 64–69.
- [14] Mirlanda, E. P., Nindiasari, H., & Syamsuri, S. (2020). Pengaruh Pembelajaran Flipped Classroom Terhadap Kemampuan Penalaran Matematis Ditinjau Dari Gaya Kognitif Siswa. *Prima: Jurnal Pendidikan Matematika*, 4(1), 11. <https://doi.org/10.31000/prima.v4i1.2081>
- [15] Naserly, M. K. (2020). Implementasi Zoom, Google Classroom, Dan Whatsapp Group Dalam Mendukung Pembelajaran Daring (Online) Pada Mata Kuliah Bahasa Inggris Lanjut. *Jurnal AKSARA PUBLIC*, 4(2), 155–165. <https://doi.org/10.1017/CBO9781107415324.004>
- [16] Özcan, Z. Ç., & Eren Gümüş, A. (2019). A modeling study to explain mathematical problem-solving performance through metacognition, self-efficacy, motivation, and anxiety. *Australian Journal of Education*, 63(1), 116–134. <https://doi.org/10.1177/0004944119840073>
- [17] Ramadhani, L., Johar, R., & Ansari, B. I. (2021). KEMAMPUAN KOMUNIKASI MATEMATIS DITINJAU DARI KETERLIBATAN SISWA MELALUI PENDEKATAN REALISTIC MATHEMATICS EDUCATION (RME). *AXIOM: Jurnal Pendidikan Dan Matematika*, 10(1), 68–84.
- [18] Tsai, Y. Hsun, Lin, C. Hung, Hong, J. Chao, & Tai, K. Hsin. (2018). The effects of metacognition on online learning interest and continuance to learn with MOOCs. *Computers and Education*, 121, 18–29. <https://doi.org/10.1016/j.compedu.2018.02.011>
- [19] Vermana, L., & Zuzano, F. (2018). Peningkatan Hasil Belajar Persamaan Diferensial Mahasiswa Pendidikan Matematika dengan Model Pembelajaran Flipped Classroom. *EDUMATICA | Jurnal Pendidikan Matematika*, 8(2), 23–34.

<https://doi.org/10.22437/edumatica.v8i2.5576>

- [20] Wayan Iliya Yuda Sukmana, A. I., & Kadek Suartama, I. (2018). Pengembangan Mobile Learning Berorientasi Model Pembelajaran Flipped Classroom Pada Mata Kuliah Multimedia. *Journal of Education Technology*, 1(2), 45–50.
- [21] Wong, J., Baars, M., Davis, D., Van Der Zee, T., Houben, G. J., & Paas, F. (2019). Supporting Self-Regulated Learning in Online Learning Environments and MOOCs: A Systematic Review. *International Journal of Human-Computer Interaction*, 35(4–5), 356–373. <https://doi.org/10.1080/10447318.2018.1543084>
- [22] Yuliawati, N. (2019). Peningkatkan Minat dan Hasil Belajar Matematika Materi Penyajian Data Melalui Model Pembelajaran Kooperatif Tipe Two Stay Two Stray (TSTS) pada Siswa Kelas VII Mts Muhammadiyah 02 Karanggede Kab. Boyolali Tahun Ajaran 2018/2019. IAIN Salatiga.
- [23] Dhita Viar Arya, Arifin Rita Wahyuni. (2022). *Media Pembelajaran Pengenalan Huruf dan Angka dengan Teknologi Augmented Reality Berbasis Mobile Pada TK Islam Insan Permata*. *Jurnal Riset Matematika*, 2(1), 1-8.