



The Effect of Flipped Classroom in Learning: A Meta-analysis

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Abstract. The primary effect of the flipped classroom on the knowledge category will be examined in this meta-analysis. There were a total of 10 papers that were chosen and met the requirements for inclusion as empirical studies of flipped classrooms in education that were done in actual classrooms. The review found that the flipped classroom had a significant positive impact on students' knowledge. No single study has ever reported negative effects, which proves this. By examining a number of articles published in both domestic and international journals, this study used the meta-analysis method. Coding is the most crucial criteria in meta-analysis to make data gathering and analysis easier. As a result, the coding categories used for this reason are listed as the tool in this meta-analysis. As a result, the findings for knowledge paint a continuously optimistic picture. The findings for the knowledge-related results indicate that the differences found are not very significant. The final striking discovery is that students in flipped classes learn a little less, but retain more of what they have learned.

Keywords: Flipped Classroom · Effect · Meta-Analysis

1 Introduction

When students use class time to enhance what they learn at home, it's called a "flipped classroom," they are completing worksheets, doing lab activities, participating in debates, or working on other projects that require higher-level thinking. There is no one right way to reverse classes [1]. The process can be differentiated to involve all students at various levels of mastery, with some students receiving additional time to work if necessary [2]. Students will watch the videos on their own and progress through a series of activities to demonstrate that they understand the material at their own pace. Anecdotal evidence suggests that the reverse class approach enhances time management and goal setting [3]. It has also been demonstrated that this instructional paradigm can accommodate a variety of learning preferences [4].

The technology in flipped classroom has been used for many years in several disciplines, especially in the humanities [5]. Since years, college-level classes at Harvard,

MIT, and Stanford have successfully applied this teaching methodology [6]. The intention is for pupils to become familiar with new content outside of the classroom before incorporating it into activities the following day.

The advantage of this flipped classroom-based learning media compared to other media is the availability of material given before class starts; it is clear that there will be time efficiency and the availability of a kind of lead-in that will bridge the initial material and the main material [7–10]. Teachers and students will have more opportunities to discuss substantial matters or even expand the scope of the material. The learning process will be more interesting because of the varied use of video or digital animation [11, 12].

The growth of the flipped classroom's use in recent years explains why it is successful in enhancing student learning outcomes in technology and education majors [13–16]. This demonstrates how the flipped classroom has given education a fresh outlook. For educators interested in flipping classes, a professional learning network was established in the beginning of 2010. As of May 2013, the network had more than 16,000 members worldwide [16]. This network offers practical assistance with technology and implementation as well as instructional conversations and best practices.

Many studies on flipped classrooms have been carried out, some of which have implemented flipped classrooms using YouTube as a complementary medium [17]. The incorporation of flipped classrooms in education is still regarded as appropriate for generating skilled graduates, particularly in the sector of vocational education, as a result of existing findings from prior studies. This study was therefore created to investigate the efficacy of the flipped classroom from both a theoretical and empirical viewpoint, in keeping with most educational institutions' campaigns to improve the quality of teaching and learning.

2 Method

2.1 Research Type

By examining a number of articles published in both domestic and international journals, this study used the meta-analysis method. Meta-analysis is quantitative in that it collects and extracts information from massive volumes of data that would otherwise be unachievable using coefficients and statistics for practical purposes. A sample of 10 publications about flipped classrooms from national and international journals were used in this meta-analysis study.

2.2 Analysis Data Technique

Coding is the most crucial criteria in meta-analysis to make data gathering and analysis easier. So listing the coding categories serves as the instrument in this meta-analysis. The name of the researcher and the year of the research, the name of the research, the academic background of the research subjects, the materials used in the research, the type of environment used, and the research dependent variable are the variables used to encode and produce the information needed to calculate the effect of flipped classroom on learning outcomes.

Steps in data tabulation (1) Specifying the variables to be studied Once located, add them to the relevant variable column; next, use the Glass equation to determine the effect size for each educational level.

3 Results and Discussions

In this article, the number of articles used is 10 articles originating from national and international journals.

Based on Table 1, it was found that based on the 10 articles used in this study, the dependent variable was learning outcomes, the type of model or method used was the flipped classroom, and the educational level was middle school and higher education.

The average effect size at both levels, namely high school and higher education, can be observed in Table 2 to be 4.9875. Therefore, the flipped classroom can enhance students' learning outcomes at both levels. Additionally, it can be observed in the Table 2 that higher education has a larger effect size than middle school. This is because students in higher education are considered to have the right level of maturity for implementing flipped classrooms. The flipped classroom is nevertheless successful at improving learning results at the secondary school level.

Table 3 illustrates the association between the typical learning results prior to and following the use of the flipped classroom. 695. According to the findings of the hypothesis

Table 1. Identification of Research Variables

No	Group Analysis	Unit Analysis	Total of Articles
1	Education Level	Vocational High School	5
		Higher Education	5
2	Dependent Variables	Learning Outcomes	10
3	Type of Model/Method	<i>Flipped classroom</i>	10

Table 2. *Effect Size* Based on Education Level

No	Education Level	Total of Articles	<i>Effect Size</i>
1	Vocational High School	5	4,641
2	Higher Education	5	5,334
Average			4,9875

Table 3. Paired Sample Correlation

	N	Correlation	Sig.
Pre and post-test	30	,695	0,05

test, H0 indicates that there is no significant change in the learning outcomes of students before utilizing the flipped classroom, and H1 indicates that there is a significant difference in those outcomes before using the flipped classroom.

The learning procedure used is that students will be given introductory material before the meeting begins, namely in the form of a video where they can watch it before learning begins. Students watch the video to find their own concept of the subject matter. When learning begins, students already have a concept of what they will learn so that students are more prepared to receive lessons.

Students have watched the subject matter before learning begins, so they have more time during learning to do assignments or have discussions related to the material that has been delivered by the teacher through videos watched before learning begins. To ensure that every student watches the video before learning begins, the students will be given basic questions related to the video. After answering questions about the video they are watching, they can access the subject matter provided by the teacher at that time. Through flipped classroom-based learning media, learning can also be done online because the flipped classroom-based learning media are in the form of e-learning. In the flipped classroom-based learning media, there are materials, questions, and discussion forums that they can use and access anywhere and anytime.

The review of recent studies assessing the effect of flipped classrooms on student learning outcomes is summarized in this section. Between 2015 and 2021, the evaluation contains recent experimental studies from a range of areas. As a result, in the first year of recent flipped classroom research, there is a gap in determining the effect of flipped classrooms on student learning outcomes. The results of existing previous studies are still equivocal, so the evidence is still inconclusive. Several studies linking flipped classrooms and student learning outcomes yield positive findings, particularly in relation to higher education. This is illustrated by [18–20], where the author examines how flipped classrooms affect the learning outcomes of students. The flipped classroom group won the comparison because their students' learning results improved as a result of the flipped classroom approach. Learning outcomes are measured based on students' abilities to focus and clarify solutions, analyze, understand, and conclude with self-regulation assessments and assumptions. The author uses self-developed questionnaires in measuring student learning outcomes. This finding is supported by the study of Cheng et al. [21], the learning results of students in a flipped classroom experiment have been measured by this author using the relevant tools. Students who use a flipped classroom strategy achieve better learning outcomes than those who use a regular teaching method.

The flipped classroom method has been employed for a long time in various areas, particularly in the humanities [22, 23]. This teaching strategy has been utilized successfully for years in college-level courses at Harvard, MIT, and Stanford. The intention is for pupils to become familiar with new content outside of the classroom before incorporating it into activities the following day.

In implementing this flipped classroom, there have been several previous studies implementing flipped classrooms along with e-learning media. This was chosen because it increases student engagement and independence in learning, enhances the quality of training materials and educational content, and increases the capacity of information technology devices to display information that would otherwise be difficult to absorb.

This also means that using multimedia resources like images, text, animation, sound, and video is much more cost-effective, meaning that saving costs for students who do not need to come to school and is available 24 h per day means mastery.

According to Sakti and Sukardi [24, 25], a clever platform like e-learning can give more feedback more rapidly, which can boost student engagement. Additionally, the format choice in the creation of learning media based on flipped classrooms is designed to design learning content and material presentation in learning. Starting with learning objectives, material descriptions, and evaluations, the chosen format is writing material in the form of media presentations. Then, in designing flipped classroom-based learning media, it was developed using Moodle. The positive impact of implementing the flipped classroom is supported by research by Asiksoy [26], who found in their study that there are statistically significant variations in student performance between the two groups, with flipped classroom users performing better than conventional method users.

4 Conclusions

Based on the review, it was determined that while various flipped classroom processes theoretically enhance student learning outcomes depending on the design used, actual data is typically equivocal in describing how flipped classrooms affect student learning outcomes, especially studies in secondary schools. Some evidence suggests that flipped classrooms require long-term exposure to boost other student abilities, and some predictors may also affect the flipped classroom relationship and learning outcomes, such as age, gender, academic achievement, and educational background, which require further research. The implication is that the curriculum for the flipped classroom must be carefully designed, paying attention to the important elements that support the flipped classroom's efficacy. This includes the role of the facilitator in mediating student learning, especially in triggering students' meta-cognitive thinking. With all of this carefully considered, the flipped classroom can succeed as stated in theory.

Acknowledgments. We really thank and appreciate to Universitas Negeri Padang and Vocational Research Centre that give great support to accomplish this research.

Authors' Contributions. Rizki Hardian Sakti: Conceptualize, design, interpret data, and draft it into articles.

Nizwardi Jalinus: Drafting, analyzing data, and reviewing articles.

Sukardi: Design, collect data, and review articles.

Rizky Ema Wulansari: Proofreading the articles.

References

1. T. Trefzger and F. Finkenber, "Flipped classroom in secondary school physics education," *IOP Conf. Series: Journal of Physics*, vol. 1286, no. 2019, pp. 1–8, 2019, <https://doi.org/10.1088/1742-6596/1286/1/012015>.

2. A. Dassa, M. H. Khuluq, and S. F. Assagaf, "Exploring Flipped Learning in Elementary Linear Algebra Class," *International Conference on Education, Science and Technology*, vol. 1387, no. 2019, pp. 1–6, 2019, <https://doi.org/10.1088/1742-6596/1387/1/012142>.
3. K. S. Chen *et al.*, "Academic outcomes of flipped classroom learning: A meta-analysis," *Med Educ*, vol. 5, no. 2, pp. 910–924, 2018, <https://doi.org/10.1111/medu.13616>.
4. R. Smith, "Flipped Learning During a Global Pandemic: Empowering Students with Choice," *International Journal of Multidisciplinary Perspectives in Higher Education*, vol. 5, no. 1, pp. 100–105, 2020, <https://doi.org/10.32674/jimphe.v5i1.2428>.
5. G. Akçayır and M. Akçayır, "The flipped classroom: A review of its advantages and challenges," *Comput Educ*, vol. 12, no. 2018, pp. 334–345, 2018, <https://doi.org/10.1016/j.compedu.2018.07.021>.
6. S. Velegol, S. Zappe, and E. Mahoney, "The Evolution of a Flipped Classroom: Evidence-Based Recommendations," *Adv Eng Educ*, vol. 5, no. 2015, pp. 1–37, 2015.
7. Waskito, Irzal, R. E. Wulansari, and K. Z. Ya, "The Adventure of Formative Assessment with Active Feedback in The Vocational Learning: The Empirical Effect for Increasing Students' Achievement," *Journal of Technical Education and Training*, vol. 14, no. 1, pp. 54–63, 2022, <https://doi.org/10.30880/jtet.2022.14.01.005>.
8. A. Huda, N. Azhar, Almasri, R. E. Wulansari, and S. Hartanto, "Augmented Reality Technology as a Complement on Graphic Design to Face Revolution Industry 4.0 Learning and Competence: The Development and Validity," *iJIM*, vol. 15, no. 05, p. 117, 2021.
9. S. Hartanto, Z. Arifin, S. L. Ratnasari, R. E. Wulansari, and A. Huda, "Developing Lean Manufacturing Based Learning Model to Improve Work Skills of Vocational Students," *Universal Journal of Educational Research*, vol. 8, no. 3A, pp. 60–64, 2020, <https://doi.org/10.13189/ujer.2020.081408>.
10. A. Huda *et al.*, "Augmented Reality Technology as a Complement on Graphic Design to Face Revolution Industry 4.0 Learning and Competence: The Development and Validity," *International Journal of Interactive Mobile Technologies*, vol. 15, no. 5, pp. 116–126, 2021, <https://doi.org/10.3991/ijim.v15i05.20905>.
11. F. Fokloun and R. H. Sakti, "The design of expert system to determine the university majoring based on multiple intelligence using forward chaining method," vol. 1, no. 1, pp. 17–24, 2022.
12. S. K. Le, S. N. Hlaing, and K. Z. Ya, "21st-century competences and learning that Technical and vocational training," *Journal of Engineering Researcher and Lecturer*, vol. 1, no. 1, pp. 1–6, Nov. 2022, <https://doi.org/10.1989/JEREL.V1I1.486>.
13. G. R. Overmyer, "The Flipped Classroom Model For College Algebra: Effects On Student Achievement," Colorado State University, 2014.
14. M. Lundin, A. Bergviken Rensfeldt, T. Hillman, A. Lantz-Andersson, and L. Peterson, "Higher education dominance and siloed knowledge: Systematic review of flipped classroom research," *International Journal of Educational Technology in Higher Education*, vol. 15, no. 1, pp. 1–20, 2018, <https://doi.org/10.1186/s41239-018-0101-6>.
15. A. Karabulut-Ilgü, N. Jaramillo Cherez, and C. T. Jahren, "A systematic review of research on the flipped learning method in engineering education," *British Journal of Educational Technology*, vol. 4, no. 9, pp. 398–411, 2018, <https://doi.org/10.1111/bjet.12548>.
16. K. F. Hew and C. K. Lo, "Flipped classroom improves student learning in health professions education: A meta-analysis," *BMC Med Educ*, vol. 18, no. 1, pp. 1–38, 2018, <https://doi.org/10.1186/s12909-018-1144-z>.
17. L. P. Rahayu, "Efektivitas Strategi Pembelajaran Flipped Classroom Pada Materi Pythagoras SMP Kelas VIII Ditinjau Berdasarkan Gender," in *Prosiding SI MaNIs (Seminar Nasional Integrasi Matematika dan Nilai Islami*, 2017, pp. 173–177.

18. R. H. Sakti and Sukardi, "THE ADVENTURE WITH CBI (COMPUTER BASED INSTRUCTION)- FLIPPED CLASSROOM IN COMPUTER NETWORKING MATERIAL," *Journal of Information Technology and Computer Science (INTECOMS)*, vol. 3, no. 2, pp. 95–101, 2020, <https://doi.org/10.31539/intecom.v3i2.1523>.
19. D. C. Kenna, "A Study Of The Effect The Flipped Classroom Model On Student Self-Efficacy," North Dakota State University, 2014.
20. J. Overmyer, "Teacher vodcasting and Flipped Classroom network - A professional learning community for teachers using vodcasting in the classroom," in *Teacher Vodcasting and Flipped Classroom Network*, 2013, pp. 1–15.
21. R. Brewer and S. Movahedazarhouli, "Successful stories and conflicts: A literature review on the effectiveness of flipped learning in higher education," *J Comput Assist Learn*, vol. 3, no. 4, pp. 409–416, 2018, <https://doi.org/10.1111/jcal.12250>.
22. H. Damayanti and Sutama., "The Effectiveness of the Flipped Classroom on the Attitudes and Skills of Learning Mathematics in SMK," *Jurnal Manajemen Pendidikan*, vol. 3, no. 1, pp. 15–22, 2016.
23. I. Moulidah, T. Ruhimat, and L. Dewi, "he Effectiveness of the Application of the Flipped Learning Model Classroom on Improving Students' Critical Thinking Ability," *DUTCEHNOLOGIA*, vol. 3, no. 3, pp. 2–8, 2017.
24. R. H. Sakti, S. Sukardi, M. Giatman, E. Nazar, W. Wakhinuddin, and W. Waskito, "Flipped Classroom-Computer Based Instruction untuk Pembelajaran Revolusi Industri 4.0: Rancang Bangun dan Analisis Kebutuhan," *Edumatic : Jurnal Pendidikan Informatika*, vol. 4, no. 1, pp. 63–72, 2020, <https://doi.org/10.29408/edumatic.v4i1.2074>.
25. R. H. Sakti and S. Sukardi, "Empirical Effect: Flipped Classroom-Based E-Learning to Face Learning on Covid-19 Pandemic," *Jurnal Pendidikan dan Pengajaran*, vol. 54, no. 1, pp. 1–8, 2021.
26. G. Aşıksoy and A. Sorakin, "The effects of clicker-aided flipped classroom model on learning achievement, physics anxiety and student' perceptions," *Int Online J Educ Teach*, vol. 5, no. 2, pp. 334–346, 2018, <https://doaj.org/article/06b7d717efd0466a84fe5a1ce2888414>.

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