Fostering personalized learning in flipped classroom: A systematic literature

Wiwik Rahayu*, Arinda Frismelly, Fenti Amelia Sari

Department of Electrical Engineering, Faculty of Engineering, Universitas Negeri Padang, **Indonesia**

*Corresponding author: wiwikrahayu@ft.unp.ac.id
Received: 22 January 2026; *Revised:* 02 April 2026; *Accepted:* 10 April 2026

Cite this https://doi.org/10.24036/jptk.v9i2.49123

Abstract: This systematic review examines the integration of personalized learning into the flipped classroom model in higher and vocational education over the past five years. The aim of this study is to examine personalization strategies in the flipped classroom, identify the supporting technologies used, and identify research gaps from previous studies. The research method employed was a literature review using the PRISMA 2020 guidelines, conducted via Scopus and Google Scholar covering the years 2019–2024, with Boolean search terms including 'personalized/individualized learning', 'flipped classroom', and 'vocational education/training'. This method yielded eleven articles, which were used to examine personalized learning in the flipped classroom. This study demonstrates improvements in achievement, motivation, engagement, and self-regulation through the use of personalized learning in the flipped classroom. Challenges encountered include platform instability, increased workload for instructors, demands for data literacy, and students' concerns regarding monitoring. It is hoped that these findings will contribute to academics, educational institutions, and policymakers in designing personalized learning within the flipped classroom.

Keywords: adaptive learning; flipped classroom; personalized learning; systematic review; vocational education

1. Introduction

Flipped classroom (FC) pedagogy, in which students learn new content outside of class (e.g., via video lectures) and use class time for active learning, has increased in use in higher education as a student-centered educational approach (Rotellar & Cain, 2016). Personalized learning refers to instruction strategies that match content, pace, and learning activities with individual students' needs, interests, and preferences (Akçayır & Akçayır, 2018). Integrating individualized learning into flipped classrooms is considered a powerful way to enhance student motivation and performance by using technology to provide each learner with customized instruction (Hu, 2022). In vocational and post-secondary educational settings, this combination can facilitate diverse learner backgrounds and independent study, perhaps leading to greater motivation and performance. The past few years have seen an explosion of literature on the topic (Alharbi, 2015), though a wide synthesis of the previous five years was needed. This systematic review examines whether personalized learning has been implemented in flipped classrooms in higher/vocational education and the effects of these personalized flipped interventions on student learning (Birgili et al., 2021).

In the last decade, empirical studies consistently supported the effectiveness of the flipped classroom at the university level. In a thorough meta-analysis, it was found that flipped instructional designs have a moderate positive effect on academic achievement across disciplines. (Goedhart et al., 2019;

Peisachovich et al., 2016). It is thanks to its ability to design active learning environments where students can transfer from theory to practice, think critically, and work with peers and teachers on complex topics rather than passively receive content. This new pedagogical methodology not only engenders improved academic outcomes but also makes students achieve, and it is because of this that it has spread to college campuses (Jang & Kim, 2020).

Enacting personalized learning methods in flipped classrooms provides a robust pedagogical synergy that has not reached (Cevikbas & Kaiser, 2022). It is noted that although there are possibilities for personalized flipped classrooms, rigorous empirical tests remain limited. Similarly, the risks and challenges, such as the inability of conceptual frameworks to be utilized to the fullest and ambiguity in the curriculum design, also need greater insight into their integration (King et al., 2017). This review addresses this gap by systematically reviewing recent literature to establish current practice, appraise reported outcomes, and identify emerging trends and challenges in embedding personalized learning in flipped classroom environments in higher and vocational education. The systematic review provides insights into practical design principles and the technologies underpinning personalized learning in flipped classroom environments by synthesizing recent empirical research. Based on the gaps identified in the literature, several research questions emerge.

To start, it is essential to investigate the effectiveness of implementing personalized learning methods in flipped-class designs as a means of augmenting student learning gains, particularly in higher and vocational education. Similarly, in parallel with this, further research is needed investigating what technologies, e.g., adaptive learning systems, AI-based recommendations, or learning analytics, are most significantly affecting student performance and interest when applied to flipped classrooms. Aside from performance, the affective aspects need to be explored as well: how does personalization impact motivation, self-regulation, and satisfaction compared to more conventional lecture- or flipped-delivery formats? Contextual differences represent another area of inquiry. The aim of this study is to identify and analyse how the flipped classroom approach is used to support or enhance personalized learning, based on previous research, and to identify the supporting technologies used for personalized learning. The scientific contribution of this study is to evaluate the effectiveness and identify research gaps to highlight the shortcomings of previous research, to link personalized learning and the flipped classroom within a more comprehensive framework of understanding, and to provide guidance to lecturers on how to implement a more personalized flipped classroom and design learning based on students' needs.

2. Methods

This systematic review followed PRISMA 2020 guidelines for transparency (Page et al., 2021). The search was optimized to identify the most up-to-date research direction and discovery regarding personalized learning in flipped classroom settings in higher and vocational education (Giannakos et al., 2014). A comprehensive search strategy of the leading academic databases, including Scopus and Google Scholar, was the initial step. We specifically designed a search query using a combination of keywords and Boolean operators to identify the key concepts: ("personalized learning" OR "individualized learning") AND ("flipped classroom" OR "inverted classroom") AND ("vocational education" OR "vocational training"). To ensure the currency of our findings, the search was limited to peer-reviewed studies published between 2019 and 2024. This approach allowed us to identify a broad but relevant pool of literature for initial screening. The study selection process followed a strict protocol based on predefined inclusion and exclusion criteria.

We only used peer-reviewed, English-language, full-text studies with empirical analysis of the implementation of both the flipped classroom approach and personalized learning in the vocational

setting. By contrast, we did not examine studies on the approaches in isolation, general higher education, or the K-12 sector, nor non-empirical articles like editorials or book reviews. In keeping with a strategy aimed at reducing selection bias, two separate reviewers screened all abstracts, titles, and full-text articles. Any disputes were settled through a unanimous discussion, and a consistent and impartial selection process was ensured.

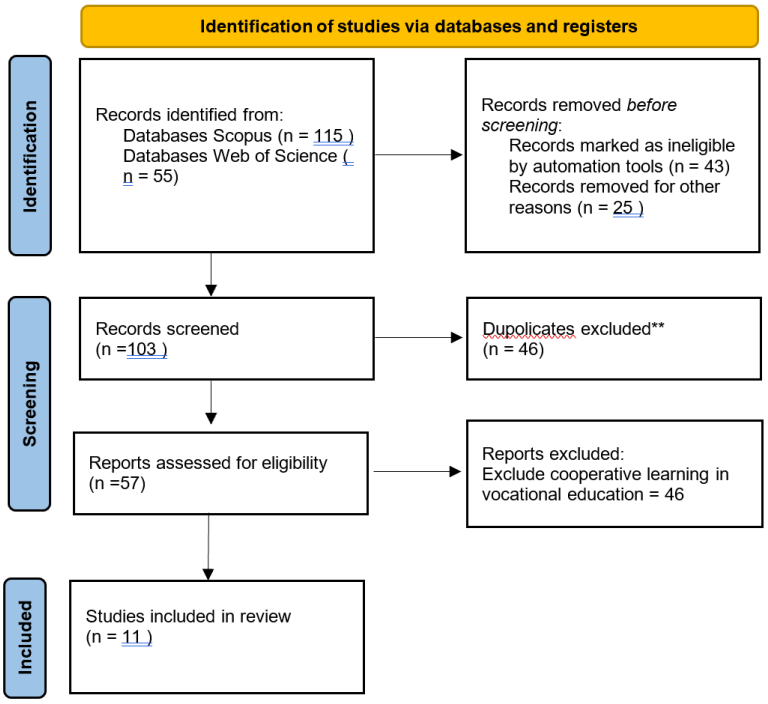

Figure 1. Article filtering process using the PRISMA method

3. Results

Summary of Included Studies. We considered 11 studies (2019–2024) on personalized learning in flipped classrooms from journal articles to a couple of conference papers. Research effort in the area has grown over the last few years, with a distinctly pointed rise towards 2020. The research spans many fields (e.g., engineering, computer science, language learning, business), but the vast majority is in STEM fields, suggesting that a personalized flipped approach is applicable mainly to technical and professional training. Most studies employed quantitative or mixed-methods designs, including quasi-experimental designs comparing a personalized flipped classroom (PFC) intervention with a control or non-personalized flipped approach. Sample sizes were generally small (tens to a few hundred participants), often in a single course.

Nearly all of the included studies used technology tools to deliver personalization, as technology integration is central to personalizing instruction in flipped classrooms. Before synthesizing the results, we first identify the general methods used to personalize flipped learning, followed by a recap of the impact on student outcomes. The review found that educators have used a variety of digital platforms, analytics, and adaptive methods to personalize flipped class learning. Table 1 summarizes the method applied in each study. In total, two complementary strategies were found: (1) adaptive learning platforms and tailored content/tools, and (2) learning analytics and intelligent systems of feedback. In addition, several studies explored other emerging technologies (AI, mobile apps, VR, etc.) to facilitate personalization.

Table 1. Comparison of included studies on personalized learning in flipped classrooms

Study (Year)	Educational context	Personalization strategy in flipped classroom	Key findings
(Araújo et al., 2020)	Undergraduate Computer Science (Distributed Systems course)	Automated personalized study guides before class, using an adaptive system (embedded in the flipped model) to provide individualized content recommendations.	Feasibility demonstrated: The system successfully generated tailored study guides per student. Instructors could monitor student progress and adjust in-class activities accordingly. Students reported positive feedback on having customized pre-class materials, which improved their readiness.
(Clark & Kaw, 2020)	Undergraduate Engineering (Numerical Methods)	Adaptive e-learning platform (Realizeit/Smart Sparrow) for pre-class modules in a flipped course; content and quizzes adapt to each learner's performance, with data used to personalize feedback.	No significant difference in exam performance was found between the personalized flipped section and a traditional flipped section in this study. However, students appreciated the immediate feedback and ability to remediate knowledge gaps via the adaptive platform. Set the groundwork for further adaptive use.
(Clark et al., 2022)	Undergraduate Engineering (Numerical Methods, remote flipped during COVID)	Adaptive lessons & analytics – extended use of the above adaptive platform in an online flipped class, plus instructor dashboards to track student progress.	Adaptive pre-class lessons showed that they helped maintain student learning outcomes even in entirely online flipped delivery. High engagement observed with the adaptive modules
(Hsieh et al., 2021)	Upper Undergraduate Engineering (Thermodynamics, online flipped course)	Flipped and adaptive online system (LearnSmart) – pre-class needs assessment and quizzes to identify individual misconceptions; live adaptive support (webinars, Q&A) targeting student "pain points."	Students' conceptual understanding improved, and anxiety was reduced through targeted support. However, some students reported lower motivation due to the highly structured, less autonomous learning process, indicating a need to balance guidance and learner agency.
(Karaoglan Yilmaz & Yilmaz, 2020)	Higher Education (Education Technology)	Learning analytics (LA)-based personalized feedback in a flipped class; tracked each student's engagement (logins, posts, etc.) and provided	Improved engagement and attitudes: LA-driven interventions enabled instructors to identify struggling students and personalize support, leading to

Study (Year)	Educational context	Personalization strategy in flipped classroom	Key findings
		customized input and recommendations.	higher participation and more positive student perceptions of the course. Students valued feedback tailored to their activity.
(Ustun et al., 2023)	Undergraduate Computing (Turkey)	LA-based adaptive feedback system – an experimental study providing some students with analytics-informed recommendations in a flipped course.	The group receiving personalized feedback and recommendations showed significantly higher performance on assessments and greater involvement compared to the control. Demonstrates the effectiveness of data-informed personalization in flipped learning.
(van Leeuwen, 2019)	University Psychology Course (Netherlands)	Teacher-led personalization via analytics reports: The instructor uses weekly learning analytics reports on student online learning activities (video watched, quizzes, etc.). Additionally, students self-report issues, which the instructor uses to adjust teaching.	Enhanced reflection and targeted support: The Instructor successfully used reports to pinpoint topics needing review and to give students individualized feedback. Students appreciated the adjustments. Instructor challenges: Noted difficulty in interpreting data and balancing various expectations, indicating support needed for teachers in using LA tools.
(Y. Chen et al., 2025)	Undergraduate Computer Science (Taiwan; Programming course)	AI-driven personalized video recommendations: An intelligent system analyzed each student's learning profile and quiz performance, then recommended specific review videos in a flipped class.	Higher engagement and selective gains: Students receiving AI-recommended videos spent more time on task (watching more videos, revisiting content), and moderately motivated students showed significantly greater improvement in test scores than peers without AI
(Louhab et al., 2020)	Undergraduate (Morocco; STEM)	Mobile context-aware flipped learning: Developed an Android app that delivers personalized content based on context (device, time, learner profile) in a flipped course.	Improved flexibility: The mobile personalized system allowed students to conveniently access tailored resources, contributing to better preparation and performance. The approach addressed device constraints

Study (Year)	Educational context	Personalization strategy in flipped classroom	Key findings
			and learning context, making the flipped study more accessible. (Study primarily reported system development; student feedback was positive on resource relevance.
(Dai & Liu, 2020)	Graduate Engineering (Japan; large class)	Personalized peer groups: A custom platform formed small peer learning groups for flipped in-class activities, based on students' backgrounds and understanding levels (from pre-class quiz feedback).	Students in the personalized heterogeneous groups reported richer discussions and peer support, as each group had a mix of strengths. Instructors found it easier to target help to groups. No formal learning outcome measure was reported, but the approach shows promise for leveraging diversity in flipped classrooms to personalize the collaborative experience.
(H.-R. Chen & Hsu, 2022)	Undergraduate Computer Science (Taiwan; Programming course)	Flipped and adaptive learning: Combined a flipped classroom with an adaptive learning system (individualized practice exercises) and compared to a regular flipped approach.	Significant gains in motivation (and performance): The personalized flipped approach led to higher student motivation than a standard flipped classroom. Students also achieved better practical coding proficiency. This case provides evidence that blending adaptive instruction with flipped learning amplifies its benefits.

Across the reviewed studies, the overall consensus is that personalized flipped classrooms improve student learning outcomes and engagement compared to traditional or non-personalized methods. About two-thirds of the studies explicitly measured student achievement (exam scores, grades, or conceptual gains) when comparing a personalized flipped approach (PFC) with a control group, and almost all reported positive effects. For example, multiple experiments have shown higher test scores or pass rates in courses that use adaptive learning in the flip model or personalized feedback mechanisms. In only two cases, no significant difference was found in learning outcomes between PFC and a regular flipped/blended class, notably the early study by and one other, suggesting that well-designed personalized interventions typically add value (Clark et al., 2022).

In addition to objective performance, many studies have examined affective and behavioral outcomes. A substantial subset 24% found that students in personalized flipped settings were more satisfied with the learning experience and expressed positive perceptions of the class. For instance, students often enjoyed the self-paced pre-class work and felt the course was more "student-centric." About 17% of studies reported increases in student engagement and motivation attributable to

personalization. This aligns with qualitative feedback in which learners noted they were more engaged when content and feedback were tailored to their needs, preventing boredom for advanced students and frustration for struggling students. Improved self-regulated learning skills were also noted in a few cases – e.g., students developed better time management and study habits when guided by personalized learning analytics reports and were able to track their own progress.

Personalized flipped classrooms also showed benefits in developing higher-order skills and socio-emotional factors. Several studies observed gains in critical thinking, problem-solving, and self-efficacy among students, attributing this to the active and individualized nature of the flipped mode. Enhanced peer collaboration and communication were reported when grouping or discussion activities were personalized to student profiles. Notably, vocational education learners, though less frequently studied, appear to respond well to flipped learning, with evidence of increased engagement and confidence. This suggests the personalized flipped approach can be practical beyond traditional academia, in skills-based and adult learning environments as well.

Although the majority of research highlights the positive impact of implementing the Personalised Flipped Classroom (PFC), some studies also report a number of challenges and mixed results. Around 12% of studies reveal that some students experience difficulties or react negatively to the implementation of this approach. One of the most frequently encountered obstacles is technical issues with the online learning platforms or adaptive systems used. When technology does not function optimally, the learning process can be disrupted and cause frustration among students. Furthermore, some students feel overwhelmed by having to adapt to a new learning format that demands higher levels of engagement, such as taking regular quizzes, using various digital devices, and interacting with a system that continuously collects their learning data. Some studies also suggest that overly intensive personalisation can have less favourable effects. When the entire learning process is overly directed by the system, some students feel they have less scope to make their own decisions regarding their learning. This situation has the potential to reduce their sense of autonomy and motivation to learn. Furthermore, maintaining student engagement in the long term also poses a challenge, particularly when the initial appeal of using technology begins to wane or when students become overly reliant on guidance and feedback.

From the teachers' perspective, the implementation of learning supported by learning analytics and adaptive systems also requires additional skills. Teachers are not only expected to understand the data generated by the system, but must also be able to translate that data into effective and relevant teaching strategies. This process is not always straightforward and requires adequate training and experience. Furthermore, there are also concerns regarding privacy and surveillance, as some students feel uncomfortable when their learning activities are continuously monitored via digital systems. Overall, these findings indicate that whilst the Personalised Flipped Classroom (PFC) holds great potential for improving the quality of learning, its success depends heavily on technological readiness, teachers' ability to utilise learning data, and a balance between providing personalised support and respecting students' autonomy in learning. By taking these factors into account, the implementation of the PFC can deliver more optimal and sustainable benefits.

4. Discussion

This systematic review provides a comprehensive overview of how personalized learning (PL) has been operationalized in flipped classrooms in recent educational research. The included studies demonstrate a range of strategies – from adaptive learning platforms and AI recommendations to analytics-informed teaching interventions – all aimed at catering to individual student needs in the flipped model (Y. Chen et al., 2025). The collective findings indicate that personalized flipped

classrooms represent an effective, technology-supported paradigm to improve learning outcomes and student experiences. In particular, PFC align with the goals of higher education and vocational training to deliver flexible, learner-centered instruction, and they appear to help address the diversity of student preparation and learning styles in those contexts (Dai & Liu, 2020). By first identifying each learner's strengths, weaknesses, and preferences (often through online data) and then tailoring content and feedback accordingly, instructors can maximize the benefits of class time for deeper learning. The review found that most PFC implementations led to better academic performance than one-size-fits-all teaching, echoing the broader trend that personalization enhances learning effectiveness when properly applied (Karaoglan Yilmaz & Yilmaz, 2020; Ustun et al., 2022; van Leeuwen, 2019).

However, the review also highlights some limitations and gaps. Geographically, research on PFC has been concentrated in certain regions (East Asia, North America, Europe), and there is an imbalance in contexts the vast majority of studies focus on university undergraduates. Vocational education settings (e.g., trade schools, on-the-job training) are underrepresented in the literature, even though personalized flipped approaches could greatly benefit learners in those environments who often have varied prior experience. In terms of methodology, most studies used small samples and short intervention periods. More large-scale, long-term studies would strengthen the evidence base, as would additional qualitative research to better understand student and teacher experiences (Giannakos et al., 2014). We also noted that while many digital tools were used, some emerging technologies have been only minimally applied so far. For instance, few studies have explored the use of augmented reality or wearable devices for personalized learning in FCs, and even AI-driven personalization is just beginning to emerge (e.g., generative AI experiments). Researchers encourage the use of these sophisticated technologies in flipped classrooms, as they could further enhance real-time personalization and engagement (Giannakos et al., 2014).

For educators and institutions, the findings of this review are encouraging. Implementing personalized learning in a flipped classroom requires careful planning and technological support, but the payoff can be substantial for student success. Instructors should start by identifying which learner data or differentiation will be most useful for their course – for example, using pre-class quizzes to gauge understanding or analytics to monitor participation- and then choose appropriate tools (or simple mechanisms) to personalize out-of-class content and in-class activities accordingly. The review's results show that even relatively straightforward interventions (such as tailored feedback emails based on quiz results or alternative video tutorials for those who scored low) can make a difference in student learning. Additionally, providing students with some choice or an adaptive pathway in the flipped homework can increase their sense of ownership. It's also essential to prepare students for the PFC approach by explaining the purpose of data collection and its benefits to their learning, thereby alleviating concerns about monitoring. On the instructor side, faculty development on data literacy and adaptive learning design is recommended, so that teachers can effectively interpret analytics and implement personalized adjustments. When challenges such as technical issues or student resistance arise, they should be addressed through iterative refinement of the approach – often, gathering student feedback can help fine-tune the balance between structure and flexibility.

5. Conclusion

In summary, findings from recent studies strongly support integrating personalized learning approaches into flipped classrooms to achieve significant improvements in student learning performance, interest, and happiness. PFC have been found to foster not only academic success (better exam results, content mastery) but also student-centered outcomes such as motivation, self-

esteem, and autonomous learning. These advantages apply across most areas of higher education and have encouraging potential for vocation and adult education, where student backgrounds are diverse. Careful planning is essential to address the difficulties; however, teachers should gradually introduce individualized elements and ensure that students remain in control of their own learning.

In short, personalized learning in flipped classrooms is a powerful nexus of pedagogical innovation and teaching technology. Over the five years of research since its inception, PFC techniques have been shown to address individual differences at scale, making learning more efficient and motivating each student. Students in such environments are found to achieve academic scores equivalent to or higher than those of their peers in conventional classrooms and report greater satisfaction and motivation, thereby addressing both the cognitive and affective components of learning. With universities and vocational schools increasingly seeking effective hybrid and online teaching models, personalized flipped classrooms offer a compelling, evidence-based approach. Future research and practice should go hand in hand to extend these strategies into new settings and develop additional uses of emerging technologies (e.g., AI and AR) to propel personalization. If adopted with caution, personalized flipped learning can help achieve the long-held promise of reaching each student where they are empowering students to reach their full potential by offering an even more responsive and dynamic learning experience.

Author's declaration

Author contribution

Wiwik Rahayu: Conceptualization; Methodology; Data curation; Writing-original draft; Visualization; Writing review & editing. **Arinda Frismelly**: Data validation; Visualization, Writing review & editing. **Fenti Amelia Sari**:Visualization; Writing-review & editing.

Funding statement

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

Acknowledgements

The author would like to thank the Department of Electrical Engineering Universitas Negeri Padang and colleagues who provided input during the preparation of this article.

Conflict of interest

The authors declare that there are no conflicts of interest relating to the research or the publication of this article.

Data availability

The data supporting the findings of this study are available from the corresponding author upon reasonable request.

Ethical clearance

Not applicable

AI statement

The author uses Grammarly to help check the grammar in the text, and ChatGPT to improve coherence, thereby enhancing readability and ensuring readers can understand the text more easily.

Publisher's and Journal's note

Universitas Negeri Padang as the publisher, and the Editor of Jurnal Pendidikan Teknologi Kejuruan state that there is no conflict of interest towards this article publication.

References

Akçayır, G., & Akçayır, M. (2018). The flipped classroom: A review of its advantages and challenges. *Computers & Education*, *126*, 334–345. https://doi.org/https://doi.org/10.1016/j.compedu.2018.07.021

Alharbi, A. H. (2015). A Flipped Learning Approach Using Social Media in Health Informatics Education. *Creative Education*, *06*(13), 1466–1475. https://doi.org/10.4236/ce.2015.613147

Araújo, P., Costa, C., Viana, W., Veras, N. de L., & Farias, E. J. P. (2020). Automatic Personalisation of Study Guides in Flipped Classroom: A Case Study in a Distributed Systems Course. *2020 IEEE Frontiers in Education Conference (FIE)*, 1–9. https://doi.org/10.1109/FIE44824.2020.9274186

Birgili, B., Seggie, F. N., & Oğuz, E. (2021). The trends and outcomes of flipped learning research between 2012 and 2018: A descriptive content analysis. *Journal of Computers in Education*, *8*(3), 365–394. https://doi.org/10.1007/s40692-021-00183-y

Cevikbas, M., & Kaiser, G. (2022). Promoting Personalized Learning in Flipped Classrooms: A Systematic Review Study. In *Sustainability (Switzerland)* (Vol. 14, Number 18). MDPI. https://doi.org/10.3390/su141811393

Chen, H.-R., & Hsu, W.-C. (2022). Do Flipped Learning and Adaptive Instruction Improve Student Learning Outcome? A Case Study of a Computer Programming Course in Taiwan. *Frontiers in Psychology*, *Volume 12*. https://www.frontiersin.org/journals/psychology/articles/10.3389/fpsyg.2021.768183

Chen, Y., Xu, Z., & Wu, C. (2025). Artificial intelligence driven personalized physical education flipped classroom design. *Journal of Computational Methods in Sciences and Engineering*. https://doi.org/10.1177/14727978251369247

Clark, R. M., & Kaw, A. (2020). Adaptive learning in a numerical methods course for engineers: Evaluation in blended and flipped classrooms. *Computer Applications in Engineering Education*, *28*(1), 62–79. https://doi.org/10.1002/cae.22175

Clark, R. M., Kaw, A. K., & Braga Gomes, R. (2022). Adaptive learning: Helpful to the flipped classroom in the online environment of COVID? *Computer Applications in Engineering Education*, *30*(2), 517–531. https://doi.org/10.1002/cae.22470

Dai, Y., & Liu, A. (2020). Personalizing Peer Instruction in a Flipped Classroom. *2020 IEEE International Conference on Teaching, Assessment, and Learning for Engineering (TALE)*, 47–54. https://doi.org/10.1109/TALE48869.2020.9368320

Giannakos, M. N., Krogstie, J., & Chrisochoides, N. (2014). Reviewing the flipped classroom research. *Proceedings of the Computer Science Education Research Conference*, 23–29. https://doi.org/10.1145/2691352.2691354

Goedhart, N. S., Blignaut-van Westrhenen, N., Moser, C., & Zweekhorst, M. B. M. (2019). The flipped classroom: supporting a diverse group of students in their learning. *Learning Environments Research*, *22*(2), 297–310. https://doi.org/10.1007/s10984-019-09281-2

Hsieh, W. L., Signorini, A., Chuang, P. Y. A., & Chen, W. F. (2021). Investigating students' experiences and perceptions of a flipped and adaptive online engineering thermodynamics class. *International Journal of Engineering Education*, *37*(2), 362–375.

Hu, J. (2022). *The Connotation of Flipped Classroom and Strategies for Practice in Higher Education BT - Proceedings of the 2022 3rd International Conference on Mental Health, Education and Human Development (MHEHD 2022)*. 206–209. https://doi.org/10.2991/assehr.k.220704.039

Jang, H. Y., & Kim, H. J. (2020). A meta-analysis of the cognitive, affective, and interpersonal outcomes of flipped classrooms in higher education. *Education Sciences*, *10*(4). https://doi.org/10.3390/educsci10040115

Karaoglan Yilmaz, F. G., & Yilmaz, R. (2020). Student opinions about personalized recommendation and feedback based on learning analytics. *Technol. Knowl. Learn*, *25*, 753–768. *Technology Knowledge and Learning*, *25*(4), 753–768. https://doi.org/10.1007/s10758-020-09460-8

King, A., Boysen-Osborn, M., Cooney, R., Mitzman, J., Misra, A., Williams, J., Dulani, T., & Gottlieb, M. (2017). Curated Collection for Educators: Five Key Papers about the Flipped Classroom Methodology. *Cureus*, *9*(10). https://doi.org/10.7759/cureus.1801

Louhab, F. E., Bahnasse, A., Bensalah, F., Khiat, A., Khiat, Y., & Talea, M. (2020). Novel approach for adaptive flipped classroom based on learning management system. *Education and Information Technologies*, *25*(2), 755–773. https://doi.org/10.1007/s10639-019-09994-0

Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., Shamseer, L., Tetzlaff, J. M., Akl, E. A., Brennan, S. E., Chou, R., Glanville, J., Grimshaw, J. M., Hróbjartsson, A., Lalu, M. M., Li, T., Loder, E. W., Mayo-Wilson, E., McDonald, S., … Moher, D. (2021). The PRISMA 2020 statement: An updated guideline for reporting systematic reviews. In *BMJ* (Vol. 372). BMJ Publishing Group. https://doi.org/10.1136/bmj.n71

Peisachovich, E. H., Murtha, S., Phillips, A., & Messinger, G. (2016). Flipping the Classroom: A Pedagogical Approach to Applying Clinical Judgment by Engaging, Interacting, and Collaborating with Nursing Students. *International Journal of Higher Education*, *5*(4), 114–121. https://doi.org/10.5430/ijhe.v5n4p114

Rotellar, C., & Cain, J. (2016). Research, Perspectives, and Recommendations on Implementing the Flipped Classroom. *American Journal of Pharmaceutical Education*, *80*(2). https://doi.org/10.5688/ajpe80234

Ustun, A. B., Zhang, K., Karaoğlan-Yilmaz, F. G., & Yilmaz, R. (2023). Learning analytics based feedback and recommendations in flipped classrooms: an experimental study in higher education. *Journal of Research on Technology in Education*, *55*(5), 841–857. https://doi.org/10.1080/15391523.2022.2040401

Ustun, Zhang, K., Karaoğlan-Yilmaz, F. G., & Yilmaz, R. (2022). Learning analytics based feedback and recommendations in flipped classrooms: An experimental study in higher education. *Journal of Research on Technology in Education, 55(5), 841–857.* https://doi.org/10.1080/15391523.2022.2040401

van Leeuwen, A. (2019). Teachers' perceptions of the usability of learning analytics reports in a flipped university course: When and how does information become actionable knowledge? *Educational Technology Research and Development, 67(5), 1043–1064.* https://doi.org/10.1007/s11423-018-09639-y