# Analysis of Chinese College Students' Learning Experience in a Blended-Flipped Classroom: Based on the Belief-Action-Outcome (BAO) Model

Weiguaju Nong[1], Huan Cao[2], and Jian-Hong Ye[3,4,*]

[1]School of Education, Guangxi University of Foreign Languages, Nanning, China
[2]Dhurakij Pundit University, Bangkok, Thailand
[3]Faculty of Education, Beijing Normal University, Beijing, China
[4]National Institute of Vocational Education, Beijing Normal University, Beijing, China

Email: nongweiguaju@gxufl.edu.cn (W.N.); weiguaju.nong@hotmail.com (W.N.); caoh1516@gmail.com (H.C.); jianhong.ye@bnu.edu.cn (J.H.Y.); kimpo30107@hotmail.com (J.H.Y.)

[*]Corresponding author

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***Abstract*—Currently, the blended learning and flipped classroom teaching method is gaining increasing popularity in higher education worldwide. Higher education institutions are adopting blended-flipped classroom teaching to enhance students' learning experiences and address the shortcomings of traditional teaching methods. This study aimed to examine the various factors influencing students' learning experiences in a research methods course. The study involved 18 third-year preschool education majors at a private undergraduate college in Guangxi, China, who had experienced blended-flipped classroom teaching. After the course concluded, semi-structured interviews were conducted to understand their learning experiences across the pre-class, in-class, and post-class stages of the blended-flipped classroom. Following the interviews, data were coded and thematically analyzed based on the Belief-Action-Outcome (BAO) model to explore the impact of beliefs on learning behaviors and outcomes. The study found that under the influence of positive learning beliefs and behaviors, students who participated in blended-flipped classroom teaching experienced improved learning outcomes and achieved positive results. This research is further enriching the application of the BAO model in the field of education, and contributing to the qualitative research on students' learning experiences with blended-flipped classrooms. Future course design can integrate ideological and political education, enhance the use of artificial intelligence, and apply knowledge graphs to support self-directed learning, enrich college students' learning experiences, and improve learning outcomes.**

***Keywords*—belief-action-outcome model, blended learning, flipped classroom, research method course, teaching reform, learning experience**

## I. Introduction

The Research Methods course is an important compulsory course for preschool education majors [1]. It aims to cultivate students' scientific research awareness, improve their research design, independent thinking, data analysis and paper writing abilities, cultivate their innovative spirit, and encourage them to develop a scientific research awareness of seeking truth from facts and being pragmatic. This can help them achieve a certain degree of scientific research literacy in the pre-employment stage. However, students generally face problems such as poor scientific research ability, lack of enthusiasm and confidence in scientific research, and ineffective cultivation of scientific research literacy [2]. As an outcome of learning in the Research Methods course, scientific research literacy has a positive impact on students' academic development. Learning experiences play a crucial role in cultivating this literacy, effectively enhancing students' competencies and positively influencing their academic outcomes when they complete research projects and write papers [3]. Learning experience is considered the interaction between students and the learning environment [4]. Historically, learning experience has been a standard for measuring educational outcomes in higher education [5]. Moreover, learning experience significantly impacts students' academic achievements. Positive learning experiences foster beneficial effects on students' thoughts and actions, promoting their development. Good learning experiences can effectively increase students' motivation and satisfaction, thereby enhancing their academic outcomes [6]. With the development of the education sector, improving students' learning experiences has become increasingly important in higher education [7]. Therefore, in order to explore the effective cultivation of students' research literacy, it is particularly important to examine the factors influencing students' learning experiences in the Research Methods course.

Understanding students' learning experiences not only helps students improve their learning methods, but also assists teachers in adjusting their teaching methods. Currently, higher education institutions are using blended learning to address the shortcomings of traditional courses and to enhance students' learning experiences [8]. When creating blended learning environments in higher education, ensuring that students have a satisfactory learning experience both online and face-to-face is crucial [9]. Therefore, exploring the factors that influence learning experiences is of great importance. Research on learning experiences from traditional courses is relatively mature, so it is imperative to invest more research into online learning methods to further understand the factors that affect students' learning experience in the online learning process [6]. In addition, teaching methods can have a positive impact on students' learning experience [10], and good teaching methods can greatly enhance students' learning experience. Therefore, it is essential to explore how students feel after being exposed to

the teaching methods. Only by truly understanding students' experiences can teaching methods be adjusted promptly to harness their positive effects, enhance students' learning experiences, promote their development, and improve their academic outcomes.

Moreover, the emergence of the COVID-19 pandemic has accelerated technological advancement and increased its integration into various industries, making it an essential part of daily work and life [11]. The education sector is no exception, as the widespread adoption of technology has transformed teaching methods. As a combination of face-to-face instruction and online learning, the teaching method of blended learning emerged. It is considered to be an appropriate teaching method for the post-pandemic era [12]. It is evident that blended learning is crucial for higher education institutions [13] and has become a trend in the development of higher education in the 21st century [14]. Blended learning offers greater flexibility compared to traditional teaching methods [9].

Flipped classrooms, supported by technology and combined with online or blended learning, have shown high adaptability and have thus now become a predominant learning model [15]. They have been widely promoted and are gradually becoming normalized. In the new educational normality, flipped classrooms have become one of the teaching models that have fundamentally transformed the scope of education [16].

Currently, blended-Flipped Classroom is becoming increasingly popular in higher education worldwide. Unlike the traditional flipped classroom, which does not necessarily incorporate blended learning, the blended-flipped classroom integrates both approaches. Students acquire fundamental knowledge through online learning and then apply and practice these concepts in offline classrooms [17]. Structured into three stages—pre-class, in-class, and post-class—the blended-flipped classroom has been shown to improve learners' academic performance, enhance self-efficacy, and effectively promote self-directed learning behaviors [18]. Karaoglan-Yilmaz *et al*. pointed out that exploring students' learning experiences is especially crucial for effectively implementing blended learning combined with the flipped classroom [19]. Therefore, amid the current normalization of the flipped classroom, investigating students' learning experiences after developing the blended-flipped classroom is key to improving student engagement and enhancing academic outcomes.

However, currently, the vast majority of research utilizes quantitative methods to understand students' learning experiences after learning in flipped classrooms. For example, studies have employed surveys to measure students' attitudes and learning experiences during flipped classroom activities [20]. Researchers have used surveys to understand students' perceptions, learning outcomes, and learning experiences in flipped classrooms [21], and scales have been used to measure factors affecting student satisfaction during the transition to online education [6]. One study conducted a teaching experiment to explore the satisfaction and self-confidence of students after using the flipped classroom method [22], while another study explored the factors that affect college students' participation and satisfaction with a flipped classroom through quantitative research [19]. Although blended method studies have explored Chinese university students' engagement after adopting the flipped classroom [23], there remains a lack of qualitative research that provides an in-depth understanding of students' learning experiences in flipped classrooms. Moreover, studies investigating students' learning experiences through qualitative research in blended-flipped classroom are even scarcer. As a result, it is difficult for teachers to determine how to improve their teaching methods, and students' learning experiences are challenging to enhance.

In addition, in novel learning environments, qualitative data are essential material for exploratory research, helping to elucidate unforeseen issues and opportunities [25]. Nong and Cao conducted a teaching experiment to explore the effects of the new blended-flipped classroom teaching method [26]. The experimental results indicated that the blended-flipped classroom had a positive impact on university students' learning, improving their learning retention rates more effectively than traditional blended teaching methods. However, their study did not explore the students' learning experiences after learning with this teaching method. Therefore, to further understand students' learning experiences after implementing blended-flipped classroom teaching, and to achieve the goal of enhancing students' learning outcomes, it is recommended that future research include a qualitative component. The study by Nong *et al*. showed that students' research confidence improved after blended-flipped classroom teaching [27]. Students were more deeply engaged in the courses and played a more dominant role in learning activities. However, the study also emphasized that future research should incorporate in-depth interviews to understand students' learning experiences.

In summary, it is necessary to use qualitative research to understand students' learning experiences after being exposed to blended-flipped classroom teaching. Garone *et al*. pointed out that researchers should understand students' results and interview students in the most direct way [28]. Therefore, this study aimed to interview college students who had participated in blended-flipped classroom teaching to understand their learning experiences in the pre-class, in-class, and post-class stages. The goal of the study was to improve students' learning methods and teachers' teaching methods, thereby enhancing students' learning experiences, improving their learning outcomes, and promoting their development. To better explain the learning experience of learners, this study takes the Belief-Action-Outcome (BAO) model as the theoretical basis. Melville's BAO model can scientifically explain individuals' sustainable behaviors and subsequent outcomes [29]. BAO model comprises three components: beliefs, actions, and outcomes. This model effectively explains the impact of an individual's beliefs on their subsequent behaviors and final outcomes. In this model, beliefs largely originate from the individual's psychological state [30], which is shaped by social and organizational structures. Individuals can improve organizations and environments through comprehensive actions [29]. Beliefs enable individuals to plan actions to achieve desired outcomes [31]. Specifically, beliefs influence individuals' behaviors regarding sustainability, and when a belief is

accepted by an individual, that individual is motivated to perform actions that are consistent with that belief [32], ultimately impacting the outcome. Previously, the BAO model was widely used in research within the technology field, but its application in the education field has been minimal. Recently, Ho *et al*. extended the BAO model to explain the relationship among learners' beliefs, actions, and outcomes in educational research [33]. Hong *et al*. further pointed out that the BAO model is a research model that can be used to explain learners' behaviors, and can be used to explain the relationship between people's abilities and beliefs about learning actions and subsequent outcomes in the education field [34]. Qian *et al*. also used the BAO model to explain the impact of beliefs on learners' behaviors, performance, and outcomes at the end of a course [35]. Therefore, based on the BAO model, this study explored students' learning experiences after participating in blended-flipped classroom teaching, further refining the application of the BAO model in the education field.

Based on above analysis, this study aims to address the following research question:

What factors influence Chinese college students' learning experiences in the blended-flipped classroom teaching model?

## II. Methodology

### A. Course implementation

The Preschool Education Research Methods course, delivered through a blended-flipped classroom approach, consists of three key phases: pre-class (understanding learning objectives, course preparation, and video watching), in-class (quizzes, activities, knowledge transfer, discussions, and teacher summaries), and post-class reflection. In the pre-class phase, students begin by clarifying the learning objectives and preparing for the lesson. They then watch instructional videos online to gain an initial understanding of the course content. After viewing the videos, students organize key concepts into mind maps, completing self-directed learning tasks to establish a solid foundation for in-class learning. During the in-class phase, students first use their mind maps to review and consolidate key concepts from the videos. The teacher then conducts a quiz to assess students' comprehension. Following the quiz, students engage in group activities where they apply their knowledge in various real-world scenarios, facilitating knowledge transfer and deeper understanding. This is followed by a highly interactive teacher-student discussion, allowing students to expand their thinking through peer and instructor interactions. As the session concludes, the teacher provides a comprehensive summary of core concepts, guiding students to reflect on their learning progress and refine their understanding. This phase fully embodies the learner-centered teaching philosophy. In the post-class phase, students engage in self-reflection, reviewing their pre-class independent learning, in-class quizzes, and knowledge application. This reflective process helps them assess their learning experience holistically and refine their understanding for future improvement.

### B. Research Process

This study followed the research ethics guidelines of the National Research Council of Thailand [36] and was approved by the Institutional Review Board (IRB) of the university. Additionally, after presenting the research proposal to the leadership of the School of Education at a private university in Guangxi, China, and obtaining consent, students from this university were invited to participate in interviews regarding the blended-flipped classroom teaching model. Before interviewing each participant, the purpose of the study, the research content, the use of data, the protection of personal privacy and other rights and interests information were explained to the participants. Interviews were conducted only after obtaining informed consent, and participants had the right to withdraw at any time during the interviews. All data collected during the study were anonymized.

### C. Research Participants

The participants selected for this study were third-year students majoring in preschool education at a private undergraduate college in Guangxi, China, who had already taken the Preschool Education Research Methods course. A portion of these students, who experienced blended-flipped classroom teaching, were invited for interviews. Guest *et al*. pointed out that data saturation occurs after 12 interviews [37]. Therefore, this study included 18 voluntary students as interview participants. Semi-structured interviews, lasting 50-60 minutes, were conducted with the participants after the course concluded to explore their learning experiences with blended-flipped classroom teaching. Among the participants, there were four males and 14 females, as shown in Table 1.

Table 1. Participant information

| Code | Gender | Age | Active learning experience | Blended learning experience |
|---|---|---|---|---|
| M-01 | Male | 22 | Yes | No |
| M-02 | Male | 23 | Yes | No |
| M-03 | Male | 21 | No | No |
| M-04 | Male | 23 | No | No |
| F-01 | Female | 23 | No | No |
| F-02 | Female | 21 | No | No |
| F-03 | Female | 21 | No | Yes |
| F-04 | Female | 22 | No | No |
| F-05 | Female | 22 | Yes | Yes |
| F-06 | Female | 23 | No | No |
| F-07 | Female | 23 | No | No |
| F-08 | Female | 22 | No | Yes |
| F-09 | Female | 22 | No | No |
| F-10 | Female | 22 | Yes | Yes |
| F-11 | Female | 22 | No | No |
| F-12 | Female | 21 | No | No |
| F-13 | Female | 23 | Yes | Yes |
| F-14 | Female | 21 | No | No |

Note. The experiences of active learning and blended learning refer to students' prior learning experiences before taking the research methods course in this study.

### D. Interview Outline

Under the BAO framework, this study focused on the learning experiences of students in the pre-class, in-class, and post-class stages of a blended-flipped classroom model. Drawing on interview questions from relevant literature on flipped classroom teaching [38], 16 interview questions were designed to understand college students' learning experiences. The content validity of these questions was reviewed and

ensured by five university teachers with master's degrees or higher in the field of education. The detailed outline is given in Table 2.

Table 2. Interview outline

| Number | Items |
|---|---|
| 1. | Did you have any experience of student-centered active learning approaches before participating in this course? |
| 2. | What aspect (or part) of this course did you like the most? |
| 3. | What aspect (or part) of this course did you like the least? |
| 4. | Compared to traditional lecture-based teaching (where the teacher lectures from start to finish), what do you think are the advantages (benefits) of the learning approach in this course? |
| 5. | Compared to traditional lecture-based teaching (where the teacher lectures from start to finish), what do you think are the disadvantages (drawbacks) of the learning approach in this course? |
| 6. | What did you gain the most from the learning way of this course? |
| 7. | Does the learning style of this course help you acquire or improve any abilities? |
| 8. | Is there any behavior improved by using the active learning method of this course? |
| 9. | What is the biggest difficulty you encountered during this course? Why? Is there any way to overcome it? (For example: too much pressure to study, lack of motivation to learn) |
| 10. | If you continue to study research methods in the future, do you want to continue to learn with such learning methods? |
| 11. | What suggestions do you have if you continue to take this course? |
| 12. | Do you want to use this way when studying other courses? |
| 13. | In the past (before the COVID-19 outbreak), did you have any experience of blended learning (combining online and offline learning)? If so, how was it conducted, and could you provide specific details? |
| 14. | What do you think are the advantages of offline + online blended learning? |
| 15. | What do you think are the disadvantages of offline and online blended learning? |
| 16. | After the pandemic ends and normal life resumes, would you still consider using blended learning (combining online and offline learning)? |

### *E. Coding and analytical methods*

The BAO model, consisting of three components—Belief, Action, and Outcome—is a research model used to explain learners' behaviors and learning experiences. Based on the BAO model, this study investigated college students' learning experiences in the pre-class, in-class, and post-class stages of blended-flipped classroom teaching. Eighteen voluntary participants were invited for interviews, during which they responded to 16 interview questions outlined in the interview guide. The whole process was recorded verbatim and organized into interview texts. According to the thematic analysis steps proposed by Braun and Clarke [41], first, the interview texts needed to be read repeatedly to familiarize the coders with the texts; second, the characteristics of the interview data were marked in a systematic way, and initial codes were created through data organization; third, different codes were classified and combined to form an overall theme; subsequently, themes were reviewed, then needed to be merged, refined, separated, or discarded; then, the themes were named and defined; finally, interview examples that were persuasive and could provide evidence for the identified themes were selected. The interview data were coded using a two-code system: the first code represents the gender and the second code represents the interviewee. For example, "M-01" indicates that the statement is from the first male interviewee, while "F-02" indicates that the statement is from the second female interviewee.

Regarding saturation analysis, after 15 interview texts were analyzed to determine the theme, the remaining three interview texts were analyzed. The results were all included in the initial codes and themes that had been obtained, and no new initial codes and themes were found. Therefore, it can be considered that this study showed saturation characteristics and had sufficient explanatory power.

## III. Results and Analysis

Table 3. Code analysis table

| Theme | Initial code | Frequency | Total |
|---|---|---|---|
| Belief | Good learning attitude | 5 | 24 |
| | Weak drivers of learning | 15 | |
| | Exclusion of traditional teaching methods | 4 | |
| Action | Teacher summary | 13 | 58 |
| | Teacher guidance / assistance | 7 | |
| | Video loop play | 13 | |
| | Improvement of academic procrastination behavior | 10 | |
| | Promotion of active learning | 15 | |
| Outcome | Improvement of self-confidence | 8 | 103 |
| | Improvement of learning retention | 12 | |
| | Improvement of bad study habits | 10 | |
| | Improvement of multiple learning abilities | 18 | |
| | Significant improvement in learning efficiency | 6 | |
| | Superior to traditional lecture-based teaching | 12 | |
| | Acceptance of the blended-flipped teaching model | 16 | |
| | Increased perceived learning pressure | 11 | |
| | Difficult knowledge of Research Methods courses | 10 | |
| Negative learning experience | Time-consuming learning process | 4 | 29 |
| | Slightly lengthy video duration | 3 | |
| | Internal disagreements within the group | 7 | |
| | Group assignment with lack of effort | 3 | |
| | Incomplete student feedback mechanism | 12 | |
| Teaching improvement strategies | Enrich course cases | 4 | 22 |
| | Improve the video length | 4 | |
| | Optimize the course design | 10 | |
| | Promote joint participation | 4 | |

To understand college students' learning experiences after being exposed to blended-flipped classroom teaching, we conducted interviews within the framework of the BAO theory. The focus of the study was on students' learning experiences during the pre-class, in-class, and post-class stages of the blended-flipped classroom. According to the steps of thematic analysis, the data of the interview text were organized to create the initial code, and the different codes were classified and combined to form five themes: belief, action, results, negative learning experience, and teaching improvement strategies. From the interviews, the study found

that beliefs affected students' learning actions and ultimately the learning outcomes obtained. Specifically, students' attitudes towards and beliefs about learning would be transformed into sustainable learning behavior, which affected their next actions. The learning behavior produced by students in the process of learning would have an impact on the result of their behavior, that is, learning performance, as shown in Table 3.

### A. Belief

The beliefs in this study refer to the students' consistent attitudes, opinions, and preferences for learning, including three initial codes named good attitude towards learning, weak drivers of learning, and exclusion of traditional teaching methods. Before participating in the blended-flipped classroom, students were influenced by their experiences in vocational education, resulting in weak motivation and a passive approach to learning, and being prone to weak willpower, attention and self-control. However, upon advancing to undergraduate studies, students recognized the importance of learning and developed a more positive attitude towards it. Moreover, they expressed dissatisfaction with traditional teaching methods, perceiving them as being rigid and teacher-centered, lacking in engagement, and failing to stimulate active knowledge acquisition. Therefore, the implementation of flipped classroom approaches was seen as being beneficial for fostering more proactive learning behaviors among students.

*I am a person who does not take the initiative to learn. I think I am really prone to procrastination, and my homework is always put off until the last minute (F-04).*

*Learning is personal, it requires me to do some introspective thinking. The world isn't static, so I can't expect it to adapt to me. Instead, I need to improve myself, become more capable, and align myself with the world around me (F-12).*

### B. Action

In this study, action refers to the behaviors exhibited by students during the implementation of the blended-flipped classroom, influenced by their beliefs. These actions included five initial codes: teacher summary, teacher guidance/assistance, video loop play, improvement of academic procrastination behavior, and promotion of active learning. When students learned in the blended-flipped classroom, they were influenced by their own and teachers' good beliefs, and they had positive learning behaviors, which effectively alleviated their procrastination. These positive learning behaviors would promote their positive learning performance.

*Compared with the traditional teaching method, the learning method of this course changed from a teacher-centered to a student-centered autonomous learning method, and the teacher changed from a lecturer to a guide (M-01).*

*The teacher's organized learning videos can assist with self-study. When encountering unfamiliar concepts while previewing the textbook, I can repeatedly watch these videos to understand better. This is something that wasn't available in traditional classroom learning (M-02).*

### C. Outcome

The outcome in this study refers to the performance of the positive or negative direction of students after learning in the blended-flipped classroom. By analyzing the interview text, the outcome showed seven positive learning performances: improvement of self-confidence, improvement of learning retention rate, improvement of bad learning habits, improvement of multiple learning abilities, significant learning efficiency, superiority over traditional lecture-based teaching, and acceptance of the blended-flipped teaching model. It consisted of two negative learning performances: increased perceived learning pressure and the difficult knowledge of the Research Methods course. In general, under the influence of students' good learning beliefs and positive learning behaviors, most of the students' learning performance was positive after learning in the blended-flipped classroom.

*I feel that online learning now is like a preliminary preview. After all, some students, like myself, don't have the habit of previewing the textbook. So, starting with online learning is akin to independent previewing. Then, through offline learning, it reinforces the knowledge, making it more firmly remembered (F-11).*

*At the beginning of this course, I couldn't understand why the teacher just sent us videos without lecturing in class. I felt like it wasn't very beneficial for me. After taking the classroom test in the last session, I was surprised by my results, but more importantly, I was happy. I feel that active learning this time has indeed had a very noticeable effect. I no longer need to cram to study (F-02).*

### D. Negative Learning Experience

In this study, negative learning experiences refers to the adverse learning experiences that students encounter during the interactive process of the blended-flipped classroom. It included five initial codes: the time-consuming learning process, slightly lengthy video duration, internal disagreements within the group, group assignment with lack of effort, and an incomplete student feedback mechanism. Based on students' negative learning experiences, teachers can adjust the teaching design accordingly to target specific areas for improvement, enhance students' learning beliefs, and strengthen collaborative learning behaviors, ultimately fostering the development of positive learning behaviors.

*Sometimes I get impatient, especially when the videos are too long. Towards the end, I forget what was discussed earlier, and I struggle to fully understand the content. It's like I sort of understand but can't articulate exactly where I'm unclear (F-02).*

*The learning atmosphere also directly affects students' learning enthusiasm. While online education allows communication with teachers online, it still cannot ensure constant interaction between teachers and students, which may result in less effective learning outcomes (F-05).*

### E. Teaching Improvement Strategies

The theme of teaching improvement strategies refers to the optimization methods adopted to better achieve the effectiveness of the blended-flipped classroom. It included four initial codes: enrich course cases, improve the video

length, optimize the course design, and promote joint participation. Through teaching improvement strategies, teachers can further enhance their lesson preparation and teaching abilities, strengthen students' learning beliefs, and reinforce their learning behaviors.

*I hope that online videos do not exceed 25 minutes. If they are longer than 25 minutes, I find watching them a bit boring because I have a short attention span. Ideally, the length of each video should be around 15 minutes so that my attention doesn't wander during video learning sessions (F-01).*

*After completing the classroom quizzes, I hope teachers can add a separate questioning session. Many students, including myself, are afraid of being called on by the teacher to answer questions. Having a dedicated questioning session could potentially increase quiz accuracy rates as well (F-04).*

## IV. Discussion

This study organized interview data to create initial codes, categorizing them into five main themes: belief, action, outcome, negative learning experience, and teaching improvement strategies. From the interviews, it is evident that beliefs influenced students' learning actions and ultimately their learning outcomes. Specifically, students' attitudes towards and beliefs about learning translated into sustainable learning behaviors, which in turn influenced their subsequent actions. The positive learning behaviors that students develop during the blended-flipped classroom teaching process have a positive impact on outcomes such as research confidence, learning retention, learning ability, and learning efficiency.

### A. Belief

The definition of belief in this study echoes Molla *et al*. [42], who pointed out that belief refers to the lasting perception and cognition of things. Through thematic analysis, it was evident that the theme of belief was composed of three initial codes: good attitude towards learning, weak drivers of learning, and exclusion of traditional teaching methods. People's beliefs about and attitudes towards the natural environment can lead to individual actions or behaviors. These then influence the behaviors of social systems and organizations. Therefore, individual (micro) and organizational (macro) factors play an important role in forming beliefs and attitudes [42]. When students are learning in a blended-flipped classroom, in addition to their previous passive attitudes, opinions and preferences, they are influenced by teachers' ideas and the new teaching methods in this learning environment. This promotes students to form positive learning attitudes and beliefs. Attitude is very important in the learning process, which is a tendency for students to acquire after learning, and has a very important impact on students' learning results. Correct learning attitude is conducive to the cultivation of good learning habits [43]. However, college students usually do not like traditional teaching methods, and believe that traditional teaching forces students to memorize what they have learned while ignoring the practical application of their knowledge [44]. These positive attitudes and ideas would have an impact on the students' behavior later.

### B. Action

The definition of action in this study echoes Hong *et al*. [34], who proposed in their study the use of the BAO theory, where action refers to the practical action in the learning process. Through thematic analysis, actions included five initial codes: teacher summary, teacher guidance/assistance, video loop play, improvement of academic procrastination behavior, and promotion of active learning. Individual beliefs can be translated into sustainable action [42]. In short, beliefs affect an individual's subsequent actions [34]. This shows that students' positive attitudes and beliefs about learning would be translated into sustainable learning behaviors, influencing their next actions. Thus, the students' delaying behavior was improved. At the same time, developing the flipped classroom has also had a positive impact on student behavior. Pre-class learning videos can be viewed an unlimited number of times to promote students' understanding of the learning materials in the videos [45]. In addition, in the process of developing the flipped classroom, teachers' summarization in class plays a positive role in promoting students' learning, as it can help students have a deeper understanding of the knowledge. In this process, the teacher is no longer the center of learning, but the person who promotes and guides students to learn [46]. Through the flipped classroom, students change from passive learning to active learning. This result is similar to the findings of Rau *et al*. [47], who observed that students participating in the flipped classroom demonstrated a close connection between their improved positive attitudes and increased engagement. Molla *et al*. noted that sustainable actions can be translated into behaviors that shape social systems and achieve organizational sustainability goals [42]. Therefore, these positive behaviors generated under the influence of beliefs would affect the following learning outcomes.

### C. Outcome

The definition of outcome in this study echoes that of Hong *et al*. [34], who emphasized in their study using BAO theory that the results refer to the outcome or performance of students in the educational environment. Through thematic analysis, the outcome showed seven positive learning performances: improvement of self-confidence, improvement of learning retention rate, improvement of bad learning habits, improvement of multiple learning abilities, significant learning efficiency, superiority over traditional lecture-based teaching, and acceptance of the blended-flipped teaching model. It consisted of two negative learning performances: increased perceived learning pressure and the difficult knowledge of the Research Methods course. In the educational context, the actual actions (behaviors) of the students ultimately influence their outcome or performance in the educational environment [34]. Flipped classrooms for active learning can improve students' learning investment, make knowledge retention more lasting, and improve their academic learning level [48]. At the same time, students can improve their learning abilities after engaging in flipped learning [49]. When students feel the fun of learning again, it may promote their academic performance and self-confidence. After their self-confidence is enhanced, students would feel power in facing learning. This sense of power makes students passionate for learning [50]. After engaging in blended-flipped classroom learning, students become more

independent learners, their interaction and learning quality improve, and their learning experiences become enriched, resulting in better educational outcomes [51]. The study by Fisher *et al*. [52] also reached similar conclusions, finding that active participation in blended-flipped classrooms significantly improved students' academic performance and satisfaction. Under the combined influence of students' strong learning beliefs and positive learning behaviors, active learning performance predominates after engaging in blended-flipped classroom learning. However, due to the inherent difficulty of the Research Methods course, students experience learning pressure during the learning process, leading to negative learning outcomes.

### *D. Negative Learning Experience*

Through thematic analysis, it is evident that in addition to belief, action, and outcome, students in the blended-flipped classroom also experienced negative learning experiences during the interactive process. These experiences included the time-consuming learning process, the slightly lengthy video duration, internal disagreements within their groups, group assignments with lack of effort, and an incomplete student feedback mechanism. Because of learning in the flipped classroom, students needed to spend extra time on self-study and had to solve problems in the learning content to prepare for the classroom activities [53]. Therefore, they spent significantly more time preparing before class than they would in a traditional teaching environment. The success of flipped learning largely depends on students' preview of course content by watching videos. The longer the videos before assisted learning, the worse the improvement of students' learning level, student participation and learning satisfaction, and long videos may even have a negative impact on students [54]. Students can thus have a negative learning experience. Moreover, beliefs about and attitudes towards the natural environment lead to individual actions or behaviors, and these can then affect the behaviors of social systems and organizations [42]. That is to say, in a learning environment, students' personal attitudes towards learning are translated into sustainable learning actions, which in turn can affect the behavior of the study group. Therefore, in the interactive process of blended learning based on the flipped classroom, students have certain negative learning experiences because of learning in small groups. Some group members lack initiative and are passive in completing group assignments, either not participating in the work or only completing simple parts of the task. Additionally, during online learning, it is difficult for teachers to monitor students' actual learning progress, and the lack of constant interaction between teachers and students can prevent timely communication and feedback. Negative learning experiences can impact students' learning beliefs, leading to adverse effects on their subsequent learning behaviors. Therefore, it is crucial for teachers to recognize these challenges and make necessary adjustments.

### *E. Teaching improvement strategies*

Teaching strategies can help students learn the required course content and develop methods to achieve future attainable goals [55]. Thematic analysis revealed that students hoped for improvements in blended-flipped classroom teaching, including more diverse course cases, more appropriate video length, optimized course design, and enhanced collaborative participation. Long *et al*. [56] pointed out that pre-class videos for blended classroom learning should be presented concisely and clearly, and should maintain a suitable pace—not too fast or too slow. Additionally, teachers should engage in reflective teaching when conducting flipped classrooms, adjusting their instructional design based on students' learning performance and modifying the pace and difficulty as needed. For example, teachers can assess students' grasp of relevant knowledge points through video questions or pre-class quizzes, and provide corresponding basic exercises to reinforce knowledge points while repeatedly explaining and practicing difficult concepts [46]. To better achieve the teaching effectiveness of the blended-flipped classroom, it is essential to optimize the instructional design. This not only improves students' learning experiences but also strengthens their positive beliefs, thereby promoting the development of constructive learning behaviors.

## V. Conclusion and Suggestions

### *A. Conclusion*

The 18 students interviewed who had participated in blended learning based on the flipped classroom indicated that good learning beliefs promoted positive learning behaviors in the learning of the Research Methods course. In the pre-class stage, students experienced the learning of understanding learning objectives, course preparation and video watching. After completing independent learning, students changed from passive to active learning. At this stage, teachers, as guides, played an auxiliary role in students' independent learning. The learning videos before class further deepened the students' memory of knowledge. After entering the classroom learning, students experienced the five links of classroom tests, classroom activities, knowledge transfer, discussion and teacher summary. Students obviously felt the learning efficiency and effect brought by this teaching method, produced active learning actions, became the main body of learning, and showed positive learning performance. The blended learning based on the flipped classroom brought an obvious learning efficiency effect, and students recognized this model and believed that the blended-flipped teaching model is better than traditional teaching. However, things typically have two sides. During the learning process, students exhibited a few negative learning behaviors. The blended-flipped classroom approach made students perceive an increase in learning pressure, and they found the Research Methods course to be challenging.

Apart from a very few interviewees who reported negative learning outcomes after participating in flipped teaching, students also experienced negative learning experiences during the interactive process of blended-flipped learning. Students found the learning time-consuming, felt that the pre-class videos were slightly lengthy, encountered internal disagreements during group activities, experienced instances of coasting through group assignments, and perceived the teacher's feedback mechanism as inadequate.

Finally, to achieve better teaching effectiveness in

blended-flipped learning, students proposed teaching improvement strategies. For instance, teachers could enrich course examples during lectures, limit the duration of pre-class videos to 15 minutes, optimize learning in both the pre-class and in-class stages, and foster collective participation among group members in group activities. In conclusion, based on the research objectives of this study, the main factors influencing students' learning experiences in the research methods course are beliefs and actions. Specifically, under the influence of positive learning beliefs and constructive learning behaviors, students experienced improved learning outcomes and had a more positive learning experience after engaging in the blended-flipped classroom teaching.

### B. Contribution

It is essential to explore the factors influencing the relationship between teaching and learning before and after instruction, as these factors are believed to impact learners' or educators' beliefs, intentions, willingness, actions (behaviors), and outcomes [57]. In other words, understanding the factors that affect learning experiences and outcomes in specific learning contexts is crucial. This study used the BAO model to explain the relationship between students' beliefs, learning behaviors, and learning outcomes after engaging in blended-flipped classroom instruction. It examined the factors influencing students' learning experiences in a Research Methods course to improve student motivation, enhance learning outcomes, and effectively cultivate students' research skills. This study also expanded the understanding of the BAO model in the field of education, further enriching related research on the BAO model in educational settings. Additionally, there is a significant lack of qualitative research in academia that specifically explores students' learning experiences after using blended-flipped classrooms. This study therefore employed qualitative methods, thereby contributing to the qualitative research on students' learning experiences in a blended-flipped classroom.

### C. Suggestions

To improve students' learning experience, teachers should control the length of pre-class videos to reduce student study time. Pre-class video learning is a crucial component of flipped classrooms. However, adolescents can typically concentrate for no more than 15 minutes, and longer videos can lead to loss of interest [46]. Compared to longer videos, shorter ones are more effective in terms of capturing learners' attention and enhancing their engagement [54]. Therefore, the duration of pre-class videos should be kept within 15 minutes to maintain students' focus and prevent cognitive overload, thereby reducing negative learning experiences. Additionally, adjusting the content of student preparatory activities and in-class group activities based on the difficulty of each chapter in the Research Methods course can also help reduce students' workload and study time, thus minimizing their negative perceptions of the study duration.

Teaching designs should include additional questioning segments. Asking questions can test students' mastery of relevant knowledge points [46]. However, considering students' emotional needs, it is important to avoid inducing excessive anxiety and to enhance students' engagement [24]. Therefore, during the face-to-face learning phase, teachers can add a student question segment either before or after quizzes, encouraging students to ask questions and stimulating their proactive learning. Additionally, enriching in-class exercises allows teachers to promptly monitor students' learning progress, helping them better grasp the knowledge.

Enriching the forms of group participation is also crucial. There is often free-riding behavior among students during group assignments. According to Hagen [58], peer assessment among group members can reduce free-riding. Implementing mechanisms such as peer evaluation and rotating group leadership can foster mutual participation among group members. Guo *et al*. suggested that group spokespersons for presentations should be chosen through random drawing [59]. Since drawing lots is random, it can to some extent promote participation among group members. Alternatively, rotating the responsibility for presenting among all group members can prevent any single member from presenting multiple times.

Furthermore, during teaching sessions, teachers should engage in reflective teaching based on feedback such as student responses to questions, attitudes towards assignments, and classroom reactions. Adjusting instructional designs according to students' actual situations helps to minimize negative learning experiences among students.

### D. Research Limitations

Although this study confirmed the effectiveness of the blended-flipped classroom through interviews, this method may be influenced by the subjectivity of the research participants. Future research could comprehensively verify the effectiveness of the blended-flipped classroom and students' learning experiences through other empirical studies and the inclusion of objective data. This study focused on a single course for preschool education majors, so future studies could expand to include interviews with students from other majors or academic fields who have experienced blended-flipped classroom teaching, thus gaining a broader understanding of students' learning experiences. Furthermore, to enhance students' learning experiences, future course designs could incorporate elements of ideological and political education, utilize emerging technologies such as artificial intelligence and metaverse tools, and apply knowledge graphs to support students' self-directed learning and improve learning outcomes. Additionally, this study confirmed the effectiveness of the blended-flipped classroom, further verification and development of student-centered learning methods or instructional models are needed due to variations in student characteristics, course modes, and content. Examples include peer review, peer discussion, collaborative learning, project-based learning, and task-driven approaches.

## Conflict of Interests

The authors declare no conflict of interest.

## Author Contributions

Weiguaju Nong: Conceptualization, Data Curation, Formal

analysis, Funding acquisition, Investigation, Methodology, Writing - Original Draft, Writing - Review & Editing. Huan Cao: Project administration, Writing - Review & Editing. Jian-Hong Ye: Conceptualization, Methodology, Supervision, Validation, Writing - Original Draft, Writing - Review & Editing. All authors have read and agreed to the published version of the manuscript.

## INSTITUTIONAL REVIEW BOARD STATEMENT

This study received approval from the Institutional Review Board (IRB) of Dhurakij Pundit University in Thailand (Approval No. 069/65). All participants provide an informed consent statement.

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## INFORMED CONSENT STATEMENT

Informed consent was obtained from all participants involved in the study.

## AVAILABILITY OF DATA

The original contributions presented in the study are included in the article; further inquiries can be directed to the corresponding author.

## REFERENCES

[1] E. C. Papanastasiou and M. Zembylas, "Anxiety in undergraduate research methods courses: Its nature and implications," *Int. J. Res. Method Educ.*, vol. 31, no. 2, pp. 155–167, 2008. doi: 10.1080/17437270802124616

[2] D. Huang and W. Nong, "Research on the cultivation path of scientific research ability of undergraduate students in preschool education—Take a case study of a private university in Guangxi," *China-Arab States Sci. Technol. Forum*, vol. 1, no. 1, pp. 138–142, 2023. doi: 10.56028/ijerd.1.1.34.2023

[3] F. Fredy, L. A. Prihandoko, and A. M. Anggawirya, "The effect of learning experience on the information literacy of students in the Ri-Png border during COVID-19 period," *Int. J. Multicult. Multireligious Underst.*, vol. 7, no. 10, pp. 171–180, 2020. doi: 10.18415/ijmmu.v7i10.2067

[4] H. K. Ning and K. Downing, "The interrelationship between student learning experience and study behaviour," *High. Educ. Res. Dev.*, vol. 30, no. 6, pp. 765–778, 2011. doi: 10.1080/07294360.2010.539598

[5] M. Nehari and H. Bender, "Meaningfulness of a learning experience: A measure for educational outcomes in higher education," *High. Educ.*, vol. 7, no. 1, pp. 1–11, 1978. doi: 10.1007/BF00129786

[6] H. Baber, "Determinants of students' perceived learning outcome and satisfaction in online learning during the pandemic of COVID-19," *J. Educ. e-Learning Res.*, vol. 7, no. 3, pp. 285–292, 2020. doi: 10.20448/journal.509.2020.73.285.292

[7] J. Poon, "Blended learning: An institutional approach for enhancing students' learning experiences," *J. Online Learn. Teach.*, vol. 9, no. 2, pp. 271–288, 2013.

[8] B. Anthony, "Examining blended learning adoption towards improving learning performance in institutions of higher education," *Technol. Knowl. Learn.*, 2024. doi: 10.1007/s10758-023-09712-3

[9] E. Ameloot *et al.*, "Supporting students' basic psychological needs and satisfaction in a blended learning environment through learning analytics," *Comput. Educ.*, vol. 209, 104949, 2024. doi: 10.1016/j.compedu.2023.104949

[10] C. Jia *et al.*, "Adaptation of a conventional flipped course to an online flipped format during the COVID-19 pandemic: Student learning performance and engagement," *J. Res. Technol. Educ.*, vol. 54, no. 2, pp. 281–301, 2022. doi: 10.1080/15391523.2020.1847220

[11] D. R. Garfin, "Technology as a coping tool during the coronavirus disease 2019 (COVID-19) pandemic: Implications and recommendations," *Stress Health*, vol. 36, no. 4, pp. 555–559, 2020. doi: 10.1002/smi.2975

[12] X. Cheng *et al.*, "Chinese anatomy educators' perceptions of blended learning in anatomy education: A national survey in the post-COVID-19 era," *Anat. Sci. Educ.*, vol. 17, no. 1, pp. 77–87, 2024. doi: 10.1002/ase.2328

[13] T. Jowsey *et al.*, "Blended learning via distance in pre-registration nursing education: A scoping review," *Nurse Educ. Pract.*, vol. 44, p. 102775, 2020. doi: 10.1016/j.nepr.2020.102775

[14] Y. Cao, J. J. Jeyaraj, and A. B. Razali, "Attitudes and perceptions of English as a foreign language students on blended learning and learner autonomy in a private university of China," *Int. J. Learn. Teach. Educ. Res.*, vol. 23, no. 1, pp. 549–571, 2024. doi: 10.26803/ijlter.23.1.26

[15] B. Divjak *et al.*, "Flipped classrooms in higher education during the COVID-19 pandemic: Findings and future research recommendations," *Int. J. Educ. Technol. High. Educ.*, vol. 19, no. 1, pp. 1–24, 2022. doi: 10.1186/s41239-021-00316-4

[16] M. J. Sosa Díaz, J. Guerra Antequera, and M. Cerezo Pizarro, "Flipped classroom in the context of higher education: Learning, satisfaction and interaction," *Educ. Sci.*, vol. 11, no. 8, p. 416, 2021. doi: 10.3390/educsci11080416

[17] N. Zwan and A. Afonso, "Activating the research methods curriculum: A blended flipped classroom," *PS: Polit. Sci. Polit.*, vol. 52, no. 4, pp. 749–753, 2019. doi: 10.1017/S1049096519000581

[18] J. He, "Construction of 'three-stage asynchronous' instructional mode of blended flipped classroom based on mobile learning platform," *Educ. Inf. Technol.*, vol. 25, no. 6, pp. 4915–4936, 2020. doi: 10.1007/s10639-020-10200-9

[19] F. G. Karaoglan-Yilmaz et al., "Transactional distance perceptions, student engagement, and course satisfaction in flipped learning: A correlational study," *Interact. Learn. Environ.*, vol. 32, no. 2, pp. 447–462, 2024. doi: 10.1080/10494820.2022.2091603

[20] M. Betaubun, "The students' attitude and learning experience toward flipped classroom implementation during COVID-19 outbreak: A survey study," *J. Pendidik. Progresif*, vol. 11, no. 1, pp. 54–62, 2021. doi: 10.23960/jpp.v11.i1.202105

[21] T. A. Barrios *et al.*, "Characterization of flipped classroom model in higher education: A perception from educational resilience during COVID-19 pandemic," *Procedia Comput. Sci.*, vol. 203, pp. 575–582, 2022. doi: 10.1016/j.procs.2022.07.082

[22] K. E. Wilson and J. R. Hobbs, "Innovative use of a flipped-classroom approach to teach fundamental nursing skills," *Teach. Learn. Nurs.*, vol. 18, no. 1, pp. 144–147, 2023. doi: 10.1016/j.teln.2022.08.002

[23] Z. Li and J. Li, "Using the flipped classroom to promote learner engagement for the sustainable development of language skills: A mixed-methods study," *Sustainability*, vol. 14, no. 10, p. 5983, 2022. doi: 10.3390/su14105983

[24] Z. Li and Y. Wang, "Adopting online flipped teaching to improve learner engagement in an English for specific purposes (ESP) course in China: A mixed-methods study," *J. China Comput.-Assist. Lang. Learn.*, vol. 3, no. 2, pp. 335–361, 2023. doi: 10.1515/jccall-2023-0001

[25] G. Palaigeorgiou and A. Papadopoulou, "Promoting self-paced learning in the elementary classroom with interactive video, an online course platform and tablets," *Educ. Inf. Technol.*, vol. 24, no. 1, pp. 805–823, 2019. doi: 10.1007/s10639-018-9804-5

[26] W. Nong and H. Cao, "The effect of blended learning and flipped classroom approaches for a research method course on undergraduate students in preschool education in China," *Int. J. High. Educ.*, vol. 12, no. 4, pp. 1–1, 2023. doi: 10.5430/ijhe.v12n4p1

[27] W. Nong, J. H. Ye, P.F. Chen, and Y. S. Lee, "A study on the blended learning effects on students majoring in preschool education in the post-pandemic era: An example of a research-method course in a Chinese university," *Front. Psychol.*, vol. 13, 962707, 2023. doi: 10.3389/fpsyg.2022.962707

[28] A. Garone *et al.*, "Evaluating professional development for blended learning in higher education: A synthesis of qualitative evidence," *Educ. Inf. Technol.*, vol. 27, no. 6, pp. 7599–7628, 2022. doi: 10.1007/s10639-022-10928-6

[29] N. P. Melville, "Information systems innovation for environmental sustainability," *MIS Q.*, vol. 34, no. 1, pp. 1–21, 2010. doi: 10.2307/20721412

[30] W. Matli and M. Phurutsi, "Extending the use of the Belief Action Outcome model during COVID-19 pandemic: Technology access review on locational disparities and inequalities for knowledge

workers," *Procedia Comput. Sci*., vol. 219, pp. 977–986, 2023. doi: 10.1016/j.procs.2023.01.375

[31] T. D. Pilditch and R. Custers, "Communicated beliefs about action-outcomes: The role of initial confirmation in the adoption and maintenance of unsupported beliefs," *Acta Psychol*., vol. 184, pp. 46–63, 2018. doi: 10.1016/j.actpsy.2017.04.006

[32] A. O. Ojo, M. Raman, and A. G. Downe, "Toward green computing practices: A Malaysian study of green belief and attitude among Information Technology professionals," *J. Clean. Prod*., vol. 224, pp. 246–255, 2019. doi: 10.1016/j.jclepro.2019.03.237

[33] Y. J. Ho *et al*., "Personalities and overconfidence predict academic procrastination and frequency of seeking research advice that influence graduate study," *J. Res. Educ. Sci*., vol. 65, no. 4, pp. 139–170, 2020. doi: 10.6209/JORIES.202012_65(4).0005

[34] J. C. Hong *et al*., "Master's study duration: The effects of active learning," *Bull. Educ. Psychol*., vol. 53, no. 4, pp. 879–900, 2022. doi: 10.6251/BEP.202206_53(4).0005

[35] C. Qian, J. H. Ye, and C. Zheng, "Integration of Shangshan culture into the STEAM curriculum and teaching: Results of an interview-based study," *Front. Psychol*., vol. 14, p. 1251497, 2023. doi: 10.3389/fpsyg.2023.1251497

[36] National Research Council of Thailand (NRCT), National Policy and Guidelines for Human Research. National Research Council of Thailand. (201)5. [Online]. Available: https://sp.mahidol.ac.th/pdf/ref/ref/National_Policy_Guidelines_for_Human_Research2015.pdf

[37] G. Guest, A. Bunce, and L. Johnson, "How many interviews are enough? An experiment with data saturation and variability," *Field Methods*, vol. 18, no. 1, pp. 59–82, 2006. doi: 10.1177/1525822X05279903

[38] K. Hava, "The effects of the flipped classroom on deep learning strategies and engagement at the undergraduate level," *Particip. Educ. Res.*, vol. 8, no. 1, pp. 379–394, 2021. doi: 10.17275/per.21.22.8.1

[39] B. Sezer and E. Abay, "Looking at the impact of the flipped classroom model in medical education," *Scand. J. Educ. Res*., vol. 63, no. 6, pp. 853–868, 2019. doi: 10.1080/00313831.2018.1452292

[40] C. C. R. Yang, "An investigation of the use of the flipped classroom pedagogy in secondary English language classrooms," *J. Inf. Technol. Educ.: Innov. Pract.*, vol. 16, no. 1, pp. 1–20, 2017. doi: 10.28945/3635

[41] V. Braun and V. Clarke, "Using thematic analysis in psychology," *Qual. Res. Psychol*., vol. 3, no. 2, pp. 77–101, 2006. doi: 10.1191/1478088706qp063oa

[42] A. Molla, A. Abareshi, and V. Cooper, "Green IT beliefs and pro-environmental IT practices among IT professionals," *Inf. Technol. People*, vol. 27, no. 2, pp. 129–154, 2014. doi: 10.1108/ITP-10-2012-0109

[43] F. Weng, H. J. Ho, R. J. Yang, and C. H. Weng, "The influence of learning style on learning attitude with multimedia teaching materials," *Eurasia J. Math. Sci. Technol. Educ*., vol. 15, no. 1, p. e1659, 2018. doi: 10.29333/ejmste/100389

[44] M. Dusenbury and M. Olson, "The impact of flipped learning on student academic performance and perceptions," *Coll. Aviat. Rev. Int*., vol. 37, no. 1, pp. 19–44, 2019. doi: 10.22488/okstate.19.100202

[45] B. M. Algarni, "Active learning strategies in the flipped classroom approach," in *Handbook of Research on Facilitating Collaborative Learning Through Digital Content and Learning Technologies*, J. Keengwe, Ed., IGI Global, 2023, pp. 384–399. doi: 10.4018/978-1-6684-5709-2.ch019

[46] C. Li, "Application of flipped classroom in second language teaching from the perspective of cognitive load theory," *Adv. Educ. Technol. Psychol*., vol. 6, no. 3, pp. 11–20, 2022. doi: 10.23977/aetp.2022.060303

[47] MA. Rau, K. Kennedy, L. Oxtoby, M. Bollom, and JW Moore, "Unpacking 'active learning': A combination of flipped classroom and collaboration support is more effective but collaboration support alone is not," *J. Chem. Educ.*, vol. 94, no. 10, pp. 1406–1414, 2017. doi: 10.1021/acs.jchemed.7b00240

[48] Ö. Tutal and T. Yazar, "Flipped classroom improves academic achievement, learning retention and attitude towards course: A meta-analysis," *Asia Pac. Educ. Rev.*, vol. 22, no. 4, pp. 655–673, 2021. doi: 10.1007/s12564-021-09706-9

[49] L. B. Schroeder, J. McGivney-Burelle, and F. Xue, "To flip or not to flip? An exploratory study comparing student performance in calculus I," *Primus*, vol. 25, no. 9–10, pp. 876–885, 2015. doi: 10.1080/10511970.2015.1050617

[50] M. K. Lee, "Flipped classroom as an alternative future class model? Implications of South Korea's social experiment," *Educ. Technol. Res. Dev.*, vol. 66, pp. 837–857, 2018. doi: 10.1007/s11423-018-9587-9

[51] A. Rahmani and K. S. Zitouni, "Blended learning and flipped classrooms application during post pandemic," *Arab World Engl. J.*, vol. 13, no. 2, pp. 451–461, 2022. doi: 10.24093/awej/vol13no2.31

[52] R. Fisher, A. Perényi, and N. Birdthistle, "The positive relationship between flipped and blended learning and student engagement, performance and satisfaction," *Act. Learn. High. Educ*., vol. 22, no. 2, pp. 97–113, 2021. doi: 10.1177/1469787418801702

[53] F. Tang *et al*., "Comparison between flipped classroom and lecture-based classroom in ophthalmology clerkship," *Med. Educ*., vol. 22, no. 1, p. 1395679, 2017. doi: 10.1080/10872981.2017.1395679

[54] Z. Yu and M. Gao, "Effects of video length on a flipped English classroom," *Sage Open*, vol. 12, no. 1, p. 21582440211068474, 2022. doi: 10.1177/21582440211068474

[55] R. D. Sarode, "Teaching strategies, styles and qualities of a teacher: A review for valuable higher education," *Int. J. Curr. Eng. Sci. Res*., vol. 5, no. 5, pp. 57–62, 2018.

[56] T. Long, J. Logan, and M. Waugh, "Students' perceptions of the value of using videos as a pre-class learning experience in the flipped classroom," *TechTrends*, vol. 60, no. 3, pp. 245–252, 2016. doi: 10.1007/s11528-016-0045-4

[57] J.-H. Ye, M.-Y. Chen, and Y.-W. Hao, "Editorial: Teaching and learning in higher education: The role of emotion and cognition," *Front. Psychol*., vol. 14, p. 1230472, 2023. doi: 10.3389/fpsyg.2023.1230472

[58] Hagen, J. P. Team-Based Learning in Physical Chemistry. The Flipped Classroom Vol. 1: Background and Challenges. ACS Symposium Series. 1223: American Chemical Society: Washington, D.C.; 2016, pp 55– 72. https://pubs.acs.org/doi/abs/10.1021/bk-2016-1223.ch005

[59] Y. Guo *et al*., "Flipped online teaching of histology and embryology with design thinking: Design, practice and reflection," *BMC Med. Educ*., vol. 24, p. 388, 2024. doi: 10.1186/s12909-024-05373-7

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