


Exploring Engagement, Learning Satisfaction, and Learning Outcomes in a Technology-Aided Self-Paced Flipped Model

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ABSTRACT

In light of the COVID-19 pandemic, the issue of self-paced flipped learning has received considerably critical attention, because the physical face-to-face classroom has become one of the major obstacles during the pandemic. This research aims to figure out the effects of self-paced flipped learning on students' learning efficiency, satisfaction, and achievements. By collecting and analyzing data from the web of science core collection, the authors concluded that the self-paced flipped learning assisted with technology was conducive to students' learning engagement, satisfaction, and outcomes; as well as their self-regulation skills, effort-invested capacity, and monitoring ability. Challenges exist for both teachers and students as this learning model demands higher investments from both sides. Future empirical research, which takes these variables into account, will need to be undertaken.

KEYWORDS

effort and monitoring, engagement, flipped model assisted with technology, satisfaction and learning outcomes, self-paced learning

1. INTRODUCTION

More recently, there has been renewed interest in self-paced learning, especially accompanying the prominence gained by the flipped pedagogical approach. As a technology-assisted pedagogical innovation, the flipped classroom is a subversive learning model, which endows learners more autonomy in learning paces and effort allocation. In a flipped classroom, learners themselves are required to obtain essential materials that are relevant to teaching before class, thus in-class time will be allocated to solve difficult problems related to the learning information (Robinson & Persky, 2020).

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In summary, flipped classrooms have the potential to transfer students from traditional instructor-driven learning to autonomous self-paced learning, which provides students the freedom to acquire the knowledge they require at their pace with the aid of teachers, peers, and various tools through online platforms (Yu & Zhu, 2019).

Many findings suggest that students, especially those from higher education, are more inclined to personalized learning, in which their unique learning requirements, goals, and paces are fully taken into account (Han & Finkelstein, 2013). Even though self-paced learning has already been proved efficient and feasible such as in medical education, physics courses, and mathematics, the application of this approach in the field of language teaching and learning is still scanty. What's more, previous relevant studies mainly focused on the strategies to cultivate self-paced learners and on how to assess self-paced learning (Robinson & Persky, 2020). Nevertheless, few studies consider the effects of self-paced learning strategies on learning efficiency and satisfaction in the technology-aided flipped model. Thus, this study provides new insights into the application of the approach.

This study, based on the above research perspectives proposed six research questions: (1) How to define self-paced learning? (2) Is there any relation between effort allocation and metacognitive monitoring in the flipped self-paced learning model? (3) Could learners' engagement be improved in the adaptive self-paced learning environment? (4) Can self-paced learning promote learning outcomes in the technology-aided flipped classrooms? (5) Can learners' satisfaction be enhanced in the flipped self-paced learning model? (6) Is there a positive correlation between learners' satisfaction and learning outcomes in the flipped self-paced learning model? These questions are concluded by reviewing and analyzing comprehensive literature, and they will be answered in detail.

2. LITERATURE REVIEW

2.1 Effort Allocation and Metacognitive Monitoring in the Self-Paced Learning Model

It is demonstrated that there is a bidirectional relation between efforts allocated to study and metacognitive monitoring judgment (Baars et al., 2020). And its direction largely rests with learners' choice of effort allocation. In the self-paced learning model, effort allocation is negatively correlated with monitoring judgment since it is, to a large extent, influenced by the easiness of memorizing. According to some researchers, judgments of learning depend on memorizing effort heuristic. Easier items are more likely to be learned. And both adults and children monitor their study based on the feedback (Anja. et al., 2010). While with strategic allocation, the correlation between the allocated effort and the monitoring judgment tends to be positive. Strategies like highlighting the importance degree of learned information and setting time limits are of great help. As researchers noted that contents are released step by step in the instructor-centered courses, while all the contents are released in the beginning in the self-paced MOOCs, thus students can study any material at any time (Moreno-Marcos et al., 2020). Therefore, a learning contract is considered an effective method to promote self-paced learning (Robinson & Persky, 2020). A learning contract is a concept borrowed from the business field, which can be considered a unanimous agreement between instructors and learners or the constraints on learners that certain work will have to be completed within the stipulated time. In case various distractions occur in the period of self-study, learning contracts can be regarded as potent measures to organize individuals and thus increase the quality of learning. In a word, students' self-regulation must be seriously considered. Besides, instructors-learners communication and learners-learners communication can be dramatically increased, which is also deemed as a significant component in Communicative Language Teaching.

2.2 Engagement and Learning Environment In the Self-Paced Learning Model

An adaptive learning environment in self-paced learning could exert a significant influence on students' engagement. An adaptive learning environment was considered as a crucial element of computer-

assisted learning systems, which provides personalized knowledge to the learner with self-directed learning (A et al., 2019). Much of the previous research has noted that personalized learning and learning environment can foster students' engagement and provide instant feedback (Han & Finkelstein 2013). Other studies have examined the positive correlation between motivation and engagement (Yu & Wang, 2016), and still, Han and Finkelstein (2013) have reported a significant role of engagement in a free and adaptive environment in building confidence. An adaptive learning environment endows learners with greater freedom and autonomy in selecting learning styles, learning contents, tools and even learning paces, which acts as great stimuli in promoting learners' motivation of learning and of interacting with instructors, peers, and materials. It is noted by many researchers that personal traits are vital components in creating adaptive learning environments (A et al., 2019), and thus it is possible to hypothesize that the respect for students' personal traits is more likely conducive to their higher motivation to engage in classroom activities. Thus, there exists a positive correlation between learners' engagement and an adaptive learning environment. Therefore, it is necessary to create an effective and adaptive learning environment in which students can receive practical assistance whether from instructors, their peers, or learning materials, technological tools, besides they can also adapt their learning paces to empirical learning practices.

2.3 Satisfaction and Learning Outcomes in the Self-Paced Learning Model

Self-paced learning in technology-aided flipped classrooms could greatly enhance learners' satisfaction and therefore lead to better learning outcomes. Some studies have postulated a convergence between satisfaction and learning outcomes in the flipped classroom (Yu & Wang, 2016), which proved that the flipped model was conducive to learning efficiency and was thus satisfactory to learners. More studies have demonstrated that learners in the flipped model could obtain better learning outcomes than those in the traditional learning environment (Yu & Zhu, 2019). Under such circumstances, learners' choice of tools or methods to achieve better performance may not be restricted, and such freedom undoubtedly motivates them and provides them with enough satisfaction which in turn results in better academic achievements. And other findings also suggest that positive emotions like satisfaction, enjoyment, and pride or so are correlated with engagement (Sandanayake & Madurapperuma, 2013). In a word, the results of these studies are rather encouraging in promoting learners' self-study. Self-paced learning can be considered a crucial remedy for the students who lack sufficient understanding both before and after class. Therefore, it is a virtuous circle. Learners' autonomy in the self-paced learning model motivates and satisfies them, which results in their better learning outcomes. To improve readability, we tabulated major findings of cited studies (Table 1).

3. METHODOLOGY

3.1 Literature Search and Analysis

This review is based on the exploration of relevant findings of past studies. The literature search was conducted in the database *Web of Science Core Collection* to obtain relevant studies. And then these relevant studies were reviewed, generalized, and analyzed to extract core ideas that serve as the supporting points of this study. When selecting relevant articles to review, we conducted a preliminary search by inputting the term "self-pace*", which was restricted to English journals and the educational field. The first search resulted in 299 articles from the *WOS core collection*. The quality of articles being reviewed can be guaranteed since they are collected from databases like Science Citation Index (Expanded SCI-EXPANDED), Social Sciences Citation Index (SSCI), Arts & Humanities Citation Index (A&HCI), and Emerging Sources Citation Index (ESCI). To refine our study, more restricted research was conducted by including the additional term "technology" with the same condition as the last search, which resulted in 167 articles in *WOS*. There was one point worth noticing that with terms "self-paced learning" and "flipped classroom" being searched simultaneously, only 14 articles

Table 1.
Major findings of primary citations in this review

N	Authors	Foci	Major findings
1	Baars & Wijnia (2018)	Promoting students' ability to self-regulate their learning accurately.	Students' high motivation for learning tasks leads to effective self-regulation skills.
2	Davies et al.(2013)	Exploring how college students may benefit from technology and the flipped model in terms of learning achievements and satisfaction.	Flipped classroom assisted with technology was both effective and measurable, under which students have higher motivation in learning.
3	Moreno-Marcos et al. (2020)	Examining how self-regulated learning (SRL) strategies are effective in reducing the dropout rate in MOOCs.	The finding suggests that event-based SRL strategies signal a good trend in reducing the dropout rate, while self-reported ones are proved inefficient in this respect.
4	Xu et al. (2019)	The new model of self-paced learning with privileged information (SPL+) can help students exploit previous knowledge.	The SPL+ model prevails over the conventional model in the aspects of recognizing action, scene, and handwriting.
5	Kember et al.(2010)	Investigating whether "information" featured format or "dialogue" one was more effective in learning outcomes.	Internet information presented in a blended environment was of low value in promoting learning outcomes while dialogue enhanced the attainment of content.
6	Aiken et al.(2020)	Examining the independent effects of the self-controlled amount- and pacing-of-practice on learning a sequential timing task.	Self-controlled learning suggests fewer errors during both immediate retention and delayed retention.
7	Mortensen & Nicholson, (2015)	Examination of students' learning gains in the flipped model.	Students in the flipped model ranked higher than those in the traditional model, and they tended to learn more and gain more help from instructors.
8	Yu (2015)	How to identify whether the clickers-aided class would enhance students' satisfaction.	Students' satisfaction was positively associated with interaction and self-regulation skills in the clickers-aided EFL class.
9	Yu & Zhu (2019)	Whether schemata activation and construction were conducive to learning in the flipped model.	In the flipped classroom, pre-class schemata help activate previous learning and promote learning activities in class.
10	Yu & Wang (2016)	Investigating the effectiveness of the flipped model in business English writing course.	Students achieved better learning outcomes and higher satisfaction in the flipped model than in the traditional one.

were available. The seemingly weird phenomenon may mean that even though the flipped model was a hot topic in education, few people considered self-paced learning in such a new teaching approach.

After obtaining all the relevant results, we exported all of them, which were clustered in terms of full records and cited references with "plain text" format. By using the program *VOSviewer*, we created a map based on bibliographic data, next we followed the instruction step by step choosing *Co-occurrence* as the type of analysis, *Full counting* as the counting method, and *All keywords* as the unit of analysis. By setting the minimum number of occurrences of a keyword at 5, 54 met the threshold of 1457 keywords. Then the total strength of the co-occurrence links with other keywords would be calculated by *VOSviewer*, and the keywords with the strongest link strength would be selected (see Figure 1).

All of the 54 items were divided into 6 clusters; cluster 1 contained 12 items, including assessment, distance education, e-learning, satisfaction, etc. Cluster 2 contained 11 items, including care, impact, implementation, knowledge, outcomes, etc. Cluster 3 contained 11 items, including achievement, student engagement, and technology, etc. Cluster 4 contained 10 items, including blended learning, higher education, motivation, etc. Cluster 5 contained 7 items, including student perceptions, web 2.0, etc. Cluster 6 contained 3 items; they are curriculum, simulation, and education.

From all of the above keywords analyzed by the program *VOSviewer*, we can grasp the basic topic and research orientation in the field of self-paced learning research. Such analysis was of great help and value for my review of these works of literature, and it greatly increased our understanding of the fundamental research orientation. The research procedure can be classified into three steps (Figure 2).

Figure 1.
Clusters of keywords in VOSviewer

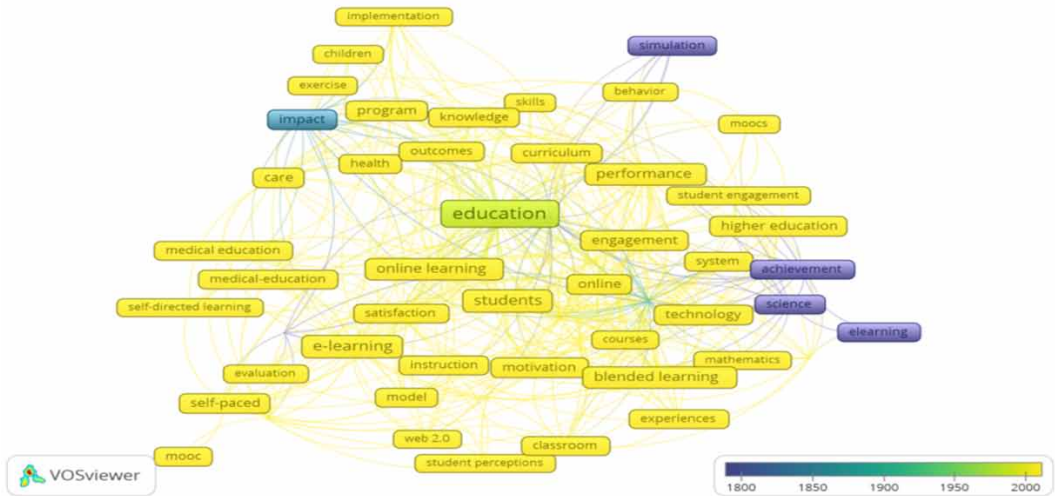
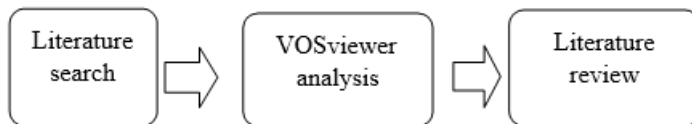


Figure 2.
Three steps in the research procedure



4. RESEARCH RESULTS

4.1 How to Define Self-Paced Learning?

Self-paced learning can be viewed as an approach to personalized learning. The report has shown that a personalized learning approach and an adaptive learning environment can improve students' engagement and provide instant feedback, what's more, strengthen students' learning motivation (Baars & Wijnia, 2018). Such an effective and interests-based learning approach can result in greater knowledge retention and less attrition contributing to mastery of knowledge and essential learning skills. Self-paced learning is deemed as significantly beneficial for learners, especially those who are struggling to keep up with peers around them. Comparing to the traditional learning approach that leads to much pressure and poor performance, self-paced learning can, to a large extent, liberate both learners and instructors. This learning approach can empower learners with freedom and autonomy to select tools and learning paces. On a deeper level, it can meet the fundamental needs of learners to determine what is related to their learning and what competence is required to obtain better performance (Ryan & Deci, 2000). On the other hand, it liberates instructors from the inherent thinking that all students should obey the same learning paces and learning principles. In addition, technological tools that are available to students, like hypermedia, are conducive to promote their understanding of complex information, track their progress and achieve their personal goals (Azevedo & Roger, 2005).

It is assumed that students perform better if the education they receive is specific to their individual needs and personalized learning pathways. According to the principles of the flipped classroom, in-class time should be allotted to engage students in significantly vital class activities and to help

them solve insoluble problems (Yu, 2015), thus out-of-class time is quite flexible to students. And some researchers noted that the essence of the flipped model is the chance for students' personalized learning during in-class activities (Jensen et al., 2015). Students can explore fundamental materials that are essential to their understanding of new information before class. During the process, their interests in learning and their critical thinking and discrimination ability will be dramatically enhanced. What's more, their time allocation capacity depending on the importance degree of items can be greatly improved. Since students have to promote their time-managing ability and organizational skills of mastering and retaining new materials and knowledge before class in the flipped model, the efficiency of the class can be guaranteed (Strelan et al., 2020). In a word, they have to make a judgment on what is beneficial to their learning, and whether the obtained information is precise or relevant to their learning. Therefore, the flipped classroom has the potential to move students from traditional instructor-centered learning to self-paced learning. And in self-paced learning, all those pre-class preparations can not only help students build confidence in cultivating self-regulation skills (Robinson & Persky, 2020), but also augment their understanding of abstract concepts (Long et al., 2016). Among various pre-class preparations, pre-class videos are verified by some researchers (Das et al., 2019) to exert a positive influence on students' acquisition, learning outcomes, and satisfaction. Thus, the self-paced learning in the flipped model can be distinctively distinguished from the traditional model either from the perspective of learning style or from the learning approach.

4.2 Is there Any Relationship Between Effort Allocation and Metacognitive Monitoring in the Flipped Self-Paced Learning Model?

Effort and monitoring are both essential concepts in the self-paced learning model. It is vital to figure out the relationship between these two items. Report (Koriat, 1997) has demonstrated that learners use quantities of cues to assess the potential of memorizing and recalling specific knowledge when taking a test. And these cues are bountiful and diversified, including learners' trust in memory, that is, how they are confident in learning and memorizing specific knowledge or learning materials. Other vital cues include the number and type of tests, the type of encoding strategies (Baars et al., 2020). Furthermore, learners' previous experiences and the difficulty level of the test items that learners perceived could also be effective cues (Koriat, 1997). Research (Baars et al., 2020) has demonstrated a negative correlation between effort allocation and monitoring judgment in problem-solving in elementary education. Yet a decisive conclusion about the negative correlation between the effort and monitoring judgment cannot be reached directly. The uncertainty of the conclusion results from variables in the experiment. How and when the relationship between these two items will be affected is unclear. (Baars et al., 2020).

Upon the comprehensive review of the research, there exists a bi-directional correlation between effort allocation and metacognitive monitoring judgments. In self-paced learning, the invested effort is data-driven (Baars et al., 2020). Learners tend to believe that they are more likely to memorize the perceived easier learning materials; consequently, it leads to a negative association between the invested effort and monitoring judgments. The negative pattern indicates that when learners' efforts increase, the monitoring judgment would tend to decrease, and they will become less confident when testing the ability to recall or understand specific learning materials. Surveys indicate that self-paced learners are more likely to take the ease of memory and perceive easier learning materials as cues. However, research also found that the negative correlation tends to be weaker for 7-to-8-year-old children compared with older children or adults (Anja. et al., 2010).

Some research also indicates that the negative correlation between effort and monitoring is not the only verdict (Koriat, 2008). If learners view learning items as possessing great value or if they show a keen interest in completing the task, the association between these two items would become positive. Compared to data-driven learning, learners in goal-driven self-study mainly invest effort based on the importance of the learning materials and their interest (Baars et al., 2020). The study has also shown that learners whether children or adults can be guided to develop self-regulation

skills by using incentives (Koriat et al., 2014). And the association between effort and metacognitive monitoring tends to be positive with higher incentives. Within the stipulated time in completing a task, learners are inclined to learn in a goal-driven way, that is, allotting time to learn and memorize the easier materials and knowledge, and thus to ensure the retention of as much knowledge as possible. Besides, learners in the flipped model can recognize their progress more easily in terms of course objectives, and they will give instant feedback and suggestions about the course (Heyborne & Perrett, 2016). Consequently, teachers can make relevant judgments about course management and design, and learners can adapt and modulate their personalized learning.

4.3 Could Learners' Engagement Be Improved in the Adaptive Self-Paced Learning Environment?

Engagement in learning activities could exert a significant influence on learning efficiency and learning effectiveness. Some researchers identified that the essence of the flipped model is active engagement in classroom activities (Jensen et al., 2015). The self-paced learning approach is most likely to unleash students' learning motivation and creativity on account of the freedom and autonomy they received. And there exists a positive correlation between motivation and students' engagement. The higher motivation of learning corresponds to the higher engagement in learning activities and vice versa (Yu et al., 2020). Without the strict constraints on learning paces, activities, and methods, learners may feel at ease and be more inclined to incorporate their creativity into their personalized learning. Therefore, it is a learning approach that takes students' feelings into full consideration, an approach different from the traditional knowledge infusion learning. Being the consultants of students' learning, teachers are no longer the center of the classroom. With a harmonious and equal relationship between learners and teachers, students are more willing to engage in classroom activities and to communicate with teachers and peers about their problems.

Quantities of evidence proved that new technologies can boost personalized learning to an unprecedented level (Means, 2014). In addition, research also showed that mighty new teaching and learning tools can help instructors to be more personalized in instructing and conveying the knowledge (Azevedo & Roger, 2005). As an example of validity, technologies that accelerate the development of student-centered learning model and help receive better learning outcomes are emerging at the post-secondary institutions around the whole US. And it is noted that the effects of these new technologies are more remarkable in self-paced learning classrooms than in classes with uniform paces (Green & Bavelier, 2012).

It is assumed that learners' engagement would be greatly improved due to their sufficient preparation before class. It is noted that students' confidence can be enhanced upon self-study before class, and then their willingness to engage in classroom activities and to collaborate with peers and teachers can be relatively stronger. Based on their preparation, they are fully aware of their cognitive level of learning knowledge. Assuming that if they can't understand certain knowledge points, their motivation to communicate with and seek help from peers and teachers must be explicit. And such high motivation is a great stimulus to promote their engagement in class because important and difficult points are targeted under such circumstances. Thus, the self-paced learning approach is a fundamental shift for the role of both instructors (Robinson & Persky, 2020) and learners. By adapting the learning process to their unique paces, learners take more responsibility for their learning. Especially, their out-of-class time can be allocated in terms of their individual needs and goals, thus this adaptive learning approach can better meet the requirements of diversified students who are from different backgrounds, either economically or geographically. What's more, the roles of teachers also face a fundamental shift from the pure knowledge conveyor and classroom authority to the facilitator and motivator of students' self-study (Robinson & Persky, 2020).

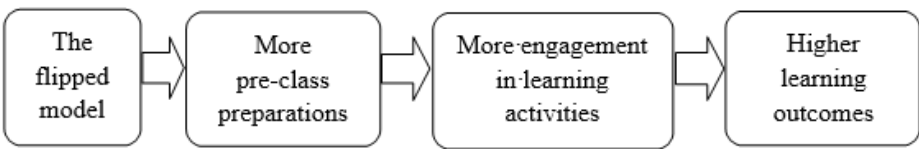
4.4 Can Self-Paced Learning Promote Learning outcomes in the Technology-Aided Flipped Classrooms?

Learning outcomes, according to some research (Yu & Wang, 2016), can be defined as academic achievements, critical thinking capacity, knowledge obtaining ability, and relevant skills in the learning process. Some researchers reveal that the quality of learning outcomes affects learners' intention to join the flipped model (Min & Bonk, 2021). Evidence suggests that adaptive multimedia course-ware can yield better learning outcomes for students, and it also has the potential to reduce instructional costs by accelerating course completion (Serafin & Wetton, 2015). From certain research, students can master the same amount of information within half amount of time when they take more effective blended courses, the courses that combine the physical in-class activities and learning activities assisted with online technologies (Yu, 2017). In addition, an increase of one-third pass rates for at-risk students was also tested in blended learning (Lovett et al., 2010). Other researchers (Lin, Hung, Kinshuk, & Chen, 2019) also examine how learner's engagement in learning activities influences their learning outcomes in the flipped classroom. The finding suggests that more participation in learning activities corresponds to higher grades. And the result shows that students who make more pre-class preparation, like watching pre-recorded videos, will participate in learning activities more actively. Coincidentally, pre-class preparation is a significant feature of the flipped model (Figure 3).

The effects of online technologies in education have already been proved and accepted. In the field of language teaching and learning, technology was considered an excellent method to make students more autonomous learners. And the impact of technology on language teaching and learning mainly reflects in two fundamental aspects: first, technology can provide diversified teaching materials and resources; second, technology can provide students with authentic learning experiences, and thus to have closer access to the target language (Larsen-Freeman & Anderson, 1986). Some scholars proposed that a combination of physical learning and online computer technologies is conducive to higher education (Kern, 2006). Others believed that interactive learning activities assisted with online technologies in blended learning can help learners achieve better learning outcomes (Kember et al., 2010). In addition, "The Effects of Student Coaching in College" report has demonstrated the positive impact of new technological tools on students' achievement. The report found that significant academic gains can be made from interventions such as IPASS at a lower cost than other interventions. Even in the field of game-assisted learning, the study has documented that computer game-assisted teaching could exert greater influence on students and produce better academic achievements than ordinary non-computer game-assisted teaching (Yu, 2018). What's more, "Action video games" were proved to be able to produce higher learning outcomes and nurture a greater ability to obtain and retain newly learned knowledge than the general way of learning (Green & Bavelier, 2012). In a word, technologies can exert a surprisingly greater influence on students' learning outcomes in their self-paced study, no matter how technologies are presented in classrooms, whether in the form of games, videos, files, or any other types.

Different voices still exist despite some findings suggest that various technologies and tools could result in better learning outcomes. Empirical findings of physics courses suggest that students taking tutorials as self-study tools flounder to apply their knowledge to solve empirical problems

Figure 3.
The logic of learning outcomes in the flipped model



(Marshman et al., 2020). Yet it is noteworthy that students perform virtually better than their peers in monitoring and one-to-one context with the aid of the same tutorials. Therefore, the problem comes down to how to define self-paced study, simply, how and to what extent monitoring works in the self-paced model. And such a problem deserves further exploration.

Another controversy lies in whether technologies can result in better academic achievements in self-paced learning. Kern (2006) notes it is not the technology itself but its practical application that promotes the acquisition of target language and culture. And how to apply the optimum technology emphasizes the important role of the teacher.

4.5 Can Learners' Satisfaction Be Enhanced in the Flipped Self-Paced Learning Model?

Learners' satisfaction is an essential variable insofar as their attitudes towards education influence the application of the learning approach (Strelan et al., 2020). The evidence suggests that the self-regulated study is correlated with higher learning satisfaction (Kuo et al., 2014). Besides, Quantities of studies have focused on learners' reaction to information technology in the flipped classroom, and the reaction mainly lies in students' satisfaction with the technology applied in the teaching. Some studies have proved that technology-aided flipped classrooms could improve students' satisfaction because a majority of them held positive attitudes toward the flipped model and such positive attitudes result in remarkable self-efficacy (Yu, 2015). The improvement of learners' satisfaction can act as a stimulus in promoting students' engagement in learning activities and in enhancing self-efficacy in autonomous self-learning (Enfield, 2013). As Ylmaz (2021) notes that students' satisfaction is one of the significant predictors of their engagement and motivation in the flipped model. Besides, an experiment has been conducted by researchers (Strelan et al., 2020) to verify students' satisfaction with the instructors and the flipped model. According to their findings, the positive influence of the flipped model on students' satisfaction can be attained. In a word, the flipped model featured with self-paced learning is proved effective in learning outcomes and thus is satisfactory to learners.

In the flipped classroom, students' learning motivation could be greatly enhanced because of their full preparation before class. In traditional teaching and learning, teachers mainly convey knowledge while students receive information passively, which piles pressure upon both teachers and students. In the traditional model, students seldom prepare for the class, or they simply scratch the surface before class, thus their previous learning experiences and existing knowledge system are difficult to activate. And such a lack of preparation is the primary reason why their enthusiasm for learning and for engaging in the class is hard to arouse. Under such circumstances, students' learning efficiency cannot be assessed easily because teachers cannot grasp students' mastery of knowledge timely, and thus prompt feedback is unavailable. Thus the traditional learning model is mainly one-way knowledge transmission, while the interaction between all sides is ignored, like learner-instructor interaction, peer interaction, and learner-content interaction. These interactions and self-efficacy are considered as good signals of students' satisfaction (Yu, 2015). Due to its failure to promote these interactions, the traditional learning model is thought to be unsatisfactory and insufficient to learners, because what learners can do is only to receive knowledge passively in class and to complete the assigned homework after class. The whole sequence of instruction is mainly dominated by teachers; students' autonomy is almost absent. Therefore, such imparity can be assumed as the leading factor that the traditional model cannot meet the diverse requirements of students.

In the flipped classroom, on the contrary, interactions are encouraged at any level. Students have to learn the learning materials before class; therefore, their previous learning experiences and existing knowledge would be activated more easily. In the physical class, they can probe into the problems with teachers and even challenge them when necessary. Furthermore, their cognitive patterns will be reinforced in the process. What's more, they are also encouraged to collaborate with peers and review learning materials after class. The whole sequence of learning is mainly student-centered. Their learning schedule will not be disturbed, and their aspiration is completely reflected in the learning

process. Therefore, students' confidence can be greatly enhanced, which leads to positive attitudes toward learning and eventually increasing satisfaction with their learning patterns.

4.6 Is There a Positive Correlation Between Learners' Satisfaction and Learning Outcomes in the Flipped Self-Paced Learning Model?

Students regard the flipped classroom as enjoyable and beneficial in that their creativity and critical thinking are greatly improved (J & M, 2015). In a word, the flipped model is accepted by students based on two basic aspects: enjoyment and benefit. The whole learning process is enjoyable for students in that their autonomy is respected and their voices are heard by teachers and peers. As a result, students' increasing interest in and satisfaction with the learning process will lead to higher engagement and thus better learning outcomes. What's more, some researchers have already concluded the positive correlation between satisfaction and self-regulation in technology-assisted EFL classes (Yu, 2015). Thus, it is doubtless that students' satisfaction will be enhanced in the technology-assisted self-learning model. Besides, numerous researchers have documented better learning outcomes for students in the flipped classroom than their counterparts in the traditional classroom. The study conducted by Yu and his colleague has proved that undergraduates majoring in business English in flipped business English writing classes obtained better learning outcomes than those in traditional English writing classes (Yu & Wang, 2016). In addition, some researchers also propose to deliver high-quality flipped classes to meet students' expectations of increasing learning outcomes, thus their satisfaction can be attained (Min & Bonk, 2021). In the field of microeconomics, the researchers noted that both students and teachers showed preference to the flipped model in that they could interact more with each other and such interaction was conducive to both teaching and learning (Lage et al., 2000). Upon reviewing comprehensive studies, the majority of them have confessed the enhanced satisfaction of both students and teachers, and better academic achievements obtained by students in the flipped model. According to these studies, we can arrive at a conclusion that there is a positive correlation between satisfaction and learning outcomes in self-paced learning assisted with technology.

While controversies also exist in that some findings indicate that there is almost no disparity between students' performance in the flipped model and the traditional model (Davies et al., 2013). Under such circumstances, some people explained that the subtle impact of the flipped model on some students did not mean that the flipped model made no sense in teaching and learning, rather this seeming failure might be due to unreasonable instructional design and unskillful implementation (Min et al., 2014). Such managerial fault makes students uneasy in learning and unfamiliar with the learning sequences. And as is mentioned above, the application of technology also plays a significant role in promoting learning outcomes. All of these views showed the importance of teacher involvement in the teaching process. As organizers of learning activities and monitors of students' learning process, teachers are considered as playing an even more important role than in traditional teaching. Therefore, these dissenting voices cannot effectively defend their argument about the low value of the flipped model since such defeat is affected by a great number of factors, rather than by the flipped model itself.

In a word, the majority of findings still support this argument that satisfaction is positively correlated with learning outcomes in flipped self-paced learning. A large number of studies show the value of such a flexible learning approach. And they all believe that its value should be overtly identified and be attached more importance. In a word, this model is worthwhile to practice for its benefits to education whether in terms of enhancing satisfaction or improving learning outcomes.

5. DISCUSSION

5.1 Difficulty in Assessing Self-Paced Learning

Generally, students are assessed from a single scale in the traditional model. They obtain corresponding scores for their performance comparing to other students. While such judgment cannot distinctly assess

students' true level of knowledge and skills acquired in the self-learning process, because students with different levels of capacity and knowledge may receive the same scores on a test. To reduce assessment errors, students can be assessed according to their overall performance on learning tasks, or more specifically, their competencies. And competencies, according to some scholars, can be defined as fundamental skills, knowledge, behaviors, and attitudes that are reflected in an excellent performance on authentic tasks or learning activities. Therefore, teachers should adopt more comprehensive assessments about students' performance, rather than one score they obtained in the final exam. Students' performance, like their reaction to the knowledge, their engagement in classroom activities, and even their out-of-class self-study management, should be taken into consideration. In a word, students' comprehensive learning ability can be accurately assessed in the flipped model in that their self-study abilities manifest that their discrimination and self-regulation are also included in the assessment.

5.2 Challenges in the Application of Self-Paced Learning

Even though self-paced learning in the flipped model is proved beneficial in many aspects, challenges in the application are still tough problems for both teachers and students. On the surface, teachers can be released from tough teaching works because many learning tasks are assigned to students. On a deeper level, teachers have to take on more responsibility. They should carefully prepare teaching materials for the class and accurately assign learning tasks prior to class. Besides, they should organize the teaching activities and activate students' motivation, what's more, interact with students as much as possible in class. Then they have to offer prompt feedback and lead students to evaluate and review what they've learned after class. These increasing tough works would undoubtedly discourage some teachers. Therefore, the complete application of this model is a question. Yet on the part of students, challenges still exist in many aspects. Firstly, self-paced learning requires strong self-discipline, since much other enjoyment, e.g., online games and irrelevant videos, may distract students. But as studies demonstrate, this can be remedied by teachers' monitor or by setting a time limit for a specific learning task. Another problem is concerned with the economic condition. Self-paced learning sets a high demand on the online network and information technology since students are required to explore relevant information on their own. Yet some students from poor economic backgrounds may not be guaranteed to access information technology. Thus, all these challenges to the application of a flipped model are in need of further investigation. Effective and practical solutions will be a potent jolt for educational progress.

6 CONCLUSION

In the backdrop of the COVID-19 pandemic, the effects of the self-paced learning model are even more apparent since physical classroom teaching is unavailable when both teachers and students are trapped at home. With its advantages of flexibility, self-paced learning is thus a good remedy to the absence of physical face-to-face teaching. That is, students can study at their paces at any time, in any situation, and be assisted with any tools. The effective application of self-paced learning owes mainly to the support of information technology, and teachers are not the only sources of information but the organizers and facilitators of learning activities. In this case, students can still obtain relevant information from a variety of sources so long as teachers assign learning tasks and promptly monitor students' learning via effective channels, like an online platform.

Even though the concept of self-paced learning is not brand new, it can be studied from different perspectives in the new backdrop. This study, based on 45 research articles and publications, explored the effects of self-paced learning on engagements, learning satisfaction and outcomes, and even the relation between invested effort and monitoring judgments in the flipped classrooms with technologies (summarized in Table 2). Thus, the study may greatly inspire teachers, students, and even educational institutions.

Teachers and educational institutions may adopt such a high-quality and effective teaching and learning model because experiments have already affirmed its' efficiency and value in reducing costs

Table 2.
A Summary of Research Perspectives and Findings in This Study

Research questions	Findings
1. How to define self-paced learning in the flipped model?	Self-paced learning in the flipped model endows learners with unprecedented autonomy in learning paces, what's more, more choices in learning tools, like hypermedia, computer educational games, online tutorials, etc. These are proved to be highly effective in learning, especially in clickers-aided flipped classrooms.
2. Does the relation between effort allocation and metacognitive monitoring in self-paced learning differ from that in the traditional model?	The relation between them is quite complicated under different circumstances. If effort invested in the study is data-driven in the self-paced model, learners are more likely to take the ease of memorizing and materials as a cue; while if the effort is goal-driven, learners may take the importance and value of materials, and the incentives into account.
3. Could learners' engagement be improved in the adaptive learning environment?	Students' engagement can be highly promoted due to various factors. First of all, their feelings are seriously considered, which leads to higher motivation. Besides, their confidence is guaranteed on account of adequate preparation before class. What's more, technology-assisted learning tools can enhance their enthusiasm to engage in classroom activities.
4. Can self-paced learning promote learning outcomes in the flipped classroom assisted with technologies?	Numerous studies have suggested that adaptive learning can yield better learning outcomes for students. What's more, the effects of online technology have been proved and verified.
5. Can learners' satisfaction be enhanced in the flipped self-paced learning?	Quantities of studies have demonstrated that students' satisfaction can be greatly enhanced in autonomous self-study, particularly; the flipped model guaranteed their autonomy in learning and the cooperation and interaction between all sides.
6. Is there a positive correlation between learners' satisfaction and learning outcomes in the flipped self-paced learning?	It is verified that students' satisfaction with their learning and the enhanced learning achievements is positively correlated in the flipped model with self-paced learning.

and improving academic achievements. Besides, in the model of self-study, students are proved to be more satisfied with their learning, and their willingness to engage in classroom activities and interact with instructors and peers is greatly enhanced. More importantly, students' personal ability is improved, especially self-regulation skills and learning modulation capacity. Therefore, this study can shed some light on how students should invest efforts to obtain better performances, and how teachers should adopt appropriate methods to motivate students, like the use of strategic cues, educational games, and online tools. More importantly, educational institutions can learn how to make strategic use of information technologies to improve the quality and efficiency of teaching, which can be achieved by applying new-class techniques and tools, like clickers-aided classrooms and hypermedia classes. While even many findings support the self-paced learning model, further empirical studies are still required to test how to promote and advocate the model in authentic teaching and learning, and how it can be accepted by more teachers, learners, and even institutions. Therefore, challenges still exist.

Admittedly, limitations cannot be denied due to various factors. First of all, research findings are limited on account of authors' restricted research analysis, thus more related studies are appreciated to extend and verify the findings. Besides, findings may be more reliable and convincing if based on all-sides experiments, which offers novel perspectives for empirical future studies. The limitations of this review are intriguing stimuli for future exploration. And all ambitious researchers can take up the responsibility of figuring out how the practical application of this model can benefit education.

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