A Quasi-Experimental Evaluation of Classes Using Traditional Methods, Problem-Based Learning, and Flipped Learning to Enhance Thai Student-Teacher Problem-Solving Skills and Academic Achievement

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Abstract—This research aimed to synthesize a review of the literature and theory to develop a flipped classroom (FC) learning model to enhance 1st-year bachelor's degree Thai student-teacher academic achievement (AA) and problem-solving skills (PSS). The sample consisted of 90 student teachers enrolled in the *Digital Media and Learning Innovation* (DMLI) course in the Elementary Education Program in the Education and Liberal Arts Faculty at a private university in southern Thailand's Songkhla Province. The study used the FC model in an experimental group (S2) (*n*=30) while simultaneously comparing it to the control (S1) group using traditional classroom methods (*n*=31) and another group (S3) using problem-based learning (PBL) (*n*=29). Nine academic experts reviewed the FC's model development. The quasi-experiment took place over four weeks in March and April 2021. All instruments were evaluated by an additional five academic experts whose input evaluation was analyzed using MANOVA statistics with IBM's® SPSS® for Windows Version 21 program. The results showed that Flipped PARSER group (S2) had AA results significantly higher than both the traditional and PBL groups. Also, S2's results concerning their PSS were significantly higher than S1 and S3, while their student-teacher satisfaction was also at the highest level. These results showed that the proposed Flipped PARSER Model excels at promoting the development of undergraduate students' motivation, academic achievement, and PSS.

Keywords—academic achievement, flipped classrooms, problem-based learning, problem-solving skills, Thailand

1 Introduction

For over two years now, the COVID-19 pandemic has shuttered great swaths of the global economy, including commerce, trade, tourism, and the education system and its related processes. In Thailand, traditional education using classrooms came to a screeching halt with the Ministry of Education (MOE) stated that under the *New Normal* education at all levels would proceed using online education and distance learning. Moreover, Thailand's MOE is shifting money and budgets once allocated to traditional schools to develop online curricula, online teaching, and digital tools and expand and upgrade information and communications technology (ICT). Therefore, under the New Normal *open online learning systems* (OOLS) and *online digital learning management* (ODLM), tool development and the enhancement of digital learning systems have become essential in the development of the education process [1] [2]. Furthermore, the vision for Thailand's education *New Normal* and its participating educational stakeholders include the vision for the transformation of learning in which 21st-century learning goals are integrated using digital technologies and teaching management tools into an online form of *digital learning ecosystems* (DLEs) [3] - [5].

Although this pandemic will eventually end, it is not easy to return Thailand or the world's education system to the pre-pandemic era. One reason is the move from the '*chalk and talk*' methods of the past were being replaced even before the pandemic started with digitally enabled pedagogies using *flipped classrooms* (FC) and *blended learning* [6], [7]. Numerous studies have now been completed on FC use, with significant evidence pointing to its effectiveness in multiple learning domains.

One study points out FC's effectiveness in increasing student engagement, while another shows how FCs increase student satisfaction [8], [9]. However, another study reports that FCs are good at promoting more independent learners and positive learning habits changes [10], while another has suggested that FC learning increases digital literacy and critical thinking skills [11].

Moreover, *blended learning* has been proven time and time again as a practical learning pedagogy, especially when combined with a flipped classroom environment [6], [12] - [14]. In research from Spain, the authors felt that although blended learning and flipped learning have different meanings, they share much in common [13]. Simply stated, blended learning is a hybrid approach between the traditional classroom and online lessons. FCs go one step further in that the teacher acts as a *facilitator* and transfers the learning process to the student who has direct access to the learning content outside the classroom.

One significant advantage to this is that learning modules can be tailored to different levels of learners who can choose when and where they review their lessons. Another advantage to flipped learning is that students can review their material until they have mastered the content [15]. Therefore, an FC allows for a *student-centered learning process*, a crucial precept for a 21st-century educational process [16], [17]. Once again, teachers act as facilitators in the instruction process [17].

However, all educational technologies that support online learning have different advantages and limitations. Therefore, faculties need to consider the best available solutions while working on continuous online teacher methods improvement. Although some universities are ready to deal with online learning, many others face significant challenges and obstacles. Therefore, the authors review and highlight some of these methods in the next section.

2 Literature review

2.1 Flipped classrooms (FC)

The genesis and evolution of the FC pedagogy can largely be attributed to the relentless march of the Internet and the related ICT infrastructure and their digital devices. As the Internet expanded out of the military and science domains and became more accessible to a broader educational community and their students, both methods and means to use expanded in numerous ways. One team of American teacher innovators saw the potential in the Internet's use and started developing lessons/modules for their students which could be viewed outside the traditional classroom. This, in turn, freed up classroom time for student activities and review of the lectures viewed outside the classroom [15].

Today, the FC pedagogy technique has moved into the education curriculum mainstream globally [18], which uses lectures in video content outside the classroom and interactive student group activities inside the classroom [19]. One such study was conducted for use in student mathematical problem-solving [20], where blended learning was enhanced with an FC environment. From the analysis of the 24 American undergraduate students, four main themes were revealed. This included relevance, reciprocal learning, teachers as facilitators, and self-efficacy. Concerning self-efficacy, it is interesting to note that the FC significantly improved the learners' confidence as they indicated the on-demand access to the content was a major contributing factor to their ability to master the material.

Moreover, [15] has added more FC advantages. These include the 1) student's ability to review each learning module until they have mastered the material, 2) transforms students into self-directed learners, 3) allows students the capability to pause their learning session to research the material, 4) the use of learning material in the student's native language, 5) allowing instructors to help students individually, and finally, 6) the use of ICT technologies which allow for higher student interaction and collaboration.

Furthermore, when an FC is integrated with blended learning in online and face-to-face instruction environments, instructors can deliver content when and where needed [20]. FCs have also been suggested as good at fostering active learning strategies [21], [22], which leads to higher levels of student satisfaction over more traditional classroom settings. Meanwhile, the teacher-led FC activities positively influence adjusting the learning outcome and fostering students' motivation [23], [24]. Also, an FC can significantly enhance a student's academic achievement (AA) over more traditional methods [14], [25]. Moreover, when the FC is integrated with PBL, it often positively influences students' behavior while also increasing their joy, motivation, and satisfaction [26].

2.2 Problem-based learning (PBL)

Past educational research has revealed that successful *problem solvers* possess a flexible and organized knowledge base, from which they can develop mastery of skills necessary in the application and transfer of *problem-solving skills* [27], [28]. Moreover, PSS are an important goal in all modern educational systems [28].

Furthermore, PBL is an approach to learning that aligns with the social constructivist framework, which advocates student-centered learning where students are problem-solvers who can think critically and creatively [29]. Also, PBL is an integral approach to learning which finds its roots in the experiential learning tradition [30].

Moreover, in a PBL classroom, instructors assume a facilitator, serving as a cognitive coach by challenging, probing, scaffolding, and monitoring students in their multifaceted problem solving [30] **-** [32]. Moreover, PBL enhances student engagement by enabling knowledge and information sharing, and discussion.

It has also been suggested that in PBL environments, better outcomes result from student group collaboration in which they are working to solve real-world problems under the guidance of their instructor [33]. Moreover, in a meta-analysis study concerning PBL, the authors determined that PBL has a significant and positive effect on the students' knowledge application [34]. However, they were also surprised that students taught using PBL techniques gained slightly less knowledge but remembered more of what they learned.

2.3 Problem-solving skills (PSS)

Problem-solving is an intellectual exercise and communication activity in which students must use their academic knowledge and creativity to collaborate and exchange knowledge and information for problem-solving and skill development appropriately and rationally [35]. Using PSS techniques, students need to evaluate the problem and conclude the best possible solution using their knowledge and abilities. According to UNESCO, this helps them prepare themselves for living in the real world and developing lifelong skills for the 21^{st}-century workforce [36].

2.4 Research objectives

So, the researchers developed and synthesized the FC technique with the following objectives:

1. To develop an FC using a PBL model to promote Thai undergraduate academic achievement and problem-solving skills.
2. To compare the effects of the flipped PARSER Model on Thai undergraduate student academic achievement and problem-solving skills with the control group (traditional) and the problem-based learning group (Figure 1).
3. To evaluate each student teacher's level of satisfaction after completing the F-PARSER DMLI course.

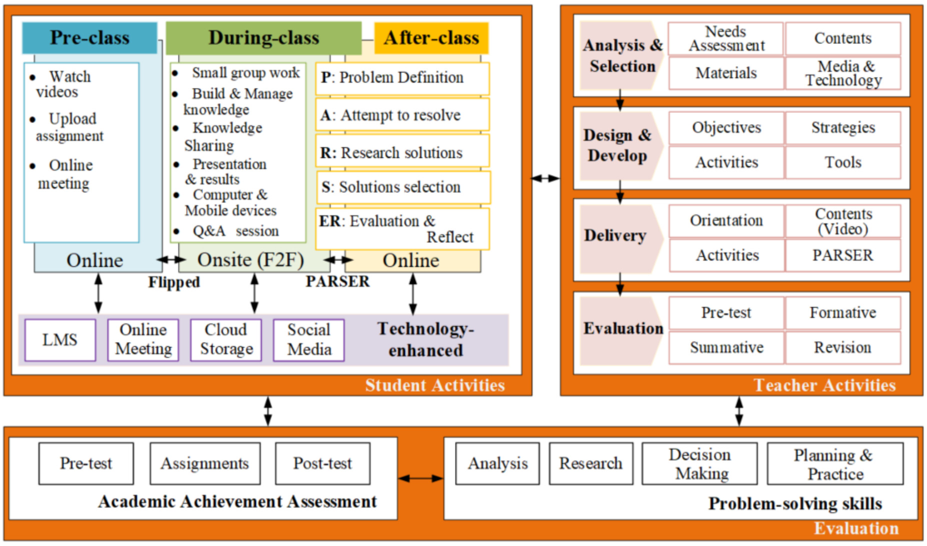

Fig. 1. Flipped PARSER model (Source: The authors)

3 Research methods

This research used a quasi-experimental method for three groups of student teachers enrolled in a *Digital Media and Learning Innovation* (DMLI) course.

3.1 Ethics clearance

Before the study was undertaken, the researchers consulted the university's Human Ethics Committee before consultation with the expert groups and student teachers. After a review of the detail, approval was granted from which all participants were informed of the confidential nature of their participation and input.

3.2 Population and sample group

The population used in this research was 90 1st year 2nd-semester undergraduate student teachers enrolled in the Elementary Education Program in the Faculty of Education and Liberal Arts at a private university in Thailand's southern province of Songkhla in 2020. Furthermore, the 90 student teachers enrolled in the *Digital Media and Learning Innovation* (DMLI) course were segmented by using simple random sampling into three groups for this study. The three groups were then established as follows:

1. Section 1 (S1) would be the control group who would be taught using traditional classroom methods (n=31).
2. Section 2 (S2) consisted of the first experimental group who would be taught using the author-developed Flipped PARSER Model (n=30).
3. Section 3 (S3) consisted of the second experimental group in which a PBL model was used to teach (n=29).

The experimental period lasted four weeks, from March 2021 to April 2021.

3.3 Research instruments

The DMLI course contained student teachers who were in their 1st-year studies for their bachelor's degree in the university's Elementary Education Program. Each DMLI course was taught for four weeks and consisted of 16 hours. Student-teacher participation was divided into three groups depending on the method/model used in the instruction process. These were:

- S1 group *(Control)* – This group was taught using traditional classroom learning methods.
- S2 group *(Experiment 1)* – This group was taught using the author developed Flipped PARSER model.
- S3 group *(Experiment 2)* – This group was taught using a PBL model.

Six experts evaluated all three classroom instruction methods. The results showed that each method used instruction techniques at an appropriateness level at the highest level (mean=4.82). Moreover, the appropriateness level of the learning media used was also judged to be at the highest level (mean=4.59).

A pre-test and post-test were conducted to evaluate each student teacher's academic achievement. Six experts in measurement and evaluation fields selected all test items with discrimination (r) and difficulty (p) in 0.20-0.80. The validity by Index of Item-Objective Congruence (IOC) was 0.67-1.00. [37].

Additionally, the reliability of the test was evaluated by thirty tryout students. The tryout's reliability was validated using the Kuder-Richardson (KR 20) evaluation process, which obtained a score of 0.80, which shows this test was valid and appropriate [38].

The problem-solving skills evaluation form was synthesized from the literature to measure student-teacher analysis, research, decision making, and planning and practice skills in problem-solving. A four-level analytic rubrics criteria method was used. The validity by IOC of the problem-solving skills evaluation form was 0.83-1.00.

The student-teacher satisfaction questionnaire concerning their participation opinions of the flipped PARSER model was evaluated by five experts. Their input showed that the questionnaire was adequate and appropriate (IOC = 0.98).

3.4 Data collection

Commencing in March 2021, the researchers used simple random sampling to identify and assign 90 1st year, 2nd-semester undergraduate student teachers to three groups who were enrolled in a *Digital Media and Learning Innovation* (DMLI) course in the Elementary Education Program in the Education and Liberal Arts Faculty at a private university in southern Thailand's Songkhla Province. The DMLI course content included the use of *Moodle Cloud*, the *KineMaster* video editing tool, and *OBS studio*.

Quality and quantity assessment was undertaken in each session and included each student's attitude, motivation, collaboration, teamwork, attention, and both individual and group behaviors during each learning session. The researchers then used the collected data to evaluate the learning status and each model's evaluation.

A content analysis was also undertaken, consisting of a needs survey and personal interviews with both the students and the instructors. Content analysis can be a valuable tool to determine the presence of certain words, themes, or concepts within some given qualitative data [39].

The researchers then designed and developed instructions, including planning and defining learning objectives, strategies, activities, materials, and evaluation tools in coordination with each DMLI instructor. Class preparation was conducted and set. This included the computer laboratory, orientation guide, learning management system (LMS), online learning media and tools, practice and assignments, proposed problems, and learning activities. Before the class's orientation, a pre-test evaluation was conducted for all three learning groups. Delivery was conducted to compare the achievement and problem-solving skills of sample groups as follows:

- S1 (Control group): This group of student teachers was taught using traditional classroom methods consisting of content lecturing, homework assignments, individual practice, group assignments, and presentation activities.
- S2 (Experimental Group 1): This student-teacher group was taught using the study's proposed Flipped PARSER Model. Model content consisted of video lecture clips of flipped homework assignments and individual practice and group assignments. Digital tools included social media platforms such as Facebook and Line supplemented by Moodle LMS, Google Drive, Google Chat Room, and a Web service provided by the university at https://www.eleclab1.kmitl.ac.th/. The Flipped PARSER's procedures were available through both synchronous and asynchronous activities, while each instructor guided and facilitated students' input from both the in-class (onsite) and outside-class (online) activities.
- S3 (Experimental Group 2): This group of student teachers were taught using PBL concepts. These included content lecturing, homework assignments, individual practice, group assignments, presentation activities, and small group collaboration. Instructors acted as facilitators and guides in discussion, research, and information exchange activities in this context.

Evaluation of academic achievement (AA) and problem-solving skills (PSS) used a pre-test, formative assessment, summative assessment, post-test, and problem-solving skills analytic rubric evaluation. The problem-solving skills' analytical rubric of analysis, research, decision making, and planning and practice skills was evaluated by three external academics who were experts in digital and media technology learning. After that, all data was collected and analyzed using descriptive and inferential statistics.

Student-teacher satisfaction (S2) of the Flipped PARSER Model was evaluated using a satisfaction questionnaire from which descriptive statistics were used for analysis. Finally, each instructor discussed all experimental observations, and the researchers refined and modified the Flipped PARSER Model better.

3.5 Data analysis

All academic achievement and problem-solving scores were analyzed using descriptive statistics using both the mean and standard deviation. The data from the three sample groups (S1, S2, and S3) used the one-way multivariate analysis of variance (one-way MANOVA) statistic for comparison purposes, which is most commonly used to ascertain if there are any differences between independent groups on more than one continuous dependent variable.

Also, a Scheffé posthoc test was performed on the group means to determine any source of significant difference [40]. Finally, all S2 student-teacher satisfaction scores were analyzed using descriptive statistics including the mean and standard deviation (SD).

4 Results

4.1 Academic achievement and problem-solving skills results

Table 1 shows that the Flipped PARSER Model group (S2) exhibited the highest academic achievement (mean = 60.14, SD = 1.88). Interestingly, S1's traditional classroom methods scored higher for academic achievement than the PBL group (S3), but this was reversed for PSS, where S3 scored higher than S1. After that, the data were tested by inferential One-Way MANOVA statistics.

Table 1. Student-teacher academic achievement and problem-solving skills by method

Model/Method	**N**	**Academic Achievement**			**Problem-Solving Skills**		
		Total	***Mean***	***SD***	***Total***	***Mean***	***SD***
F-PARSER (S2)	30	100	60.14	1.88	100	68.76	0.37
Traditional (S1)	31	100	47.83	2.13	100	60.42	0.28
PBL)S3)	29	100	45.20	1.32	100	63.91	0.31

4.2 One-way MANOVA results

The one-way MANOVA's assumptions were tested as follows:

1. Normality was analyzed using the Shapiro-Wilk test in which the academic achievement of S1, S2, and S3 was determined to be .351, .177, and .055, respectively. Additionally, the problem-solving skills of S1, S2, and S3 were .677, .062, and .133, respectively. All Shapiro-Wilk's testing significance was higher than ∝ .05 (Sig > ∝). Therefore, all data distributions were normal and met the requirement of MANOVA's assumption.
2. The homogeneity of covariance matrices test was analyzed using Box's M test, from which the Box's M statistic = 9.959, F value = 1.605, df1 = 6, df2 = 1.849E5, and Sig = 0.141. It was higher than ∝ .05 (Sig > ∝). Therefore, the variance co-variance matrices were not different and met the requirement of MANOVA's assumption.
3. Multicollinearity correlation of the dependent variable was analyzed using Bartlett's Test of Sphericity which is a feature available when using IBM's® SPSS® for Windows Version 21 program. The testing concluded that the likelihood ratio = 0.000, approximate Chi-Square = 194.591, df = 2, Sig = .000*. It was less than ∝ .05 (Sig < ∝). Therefore, academic achievement and the problem-solving skills variables did not have a multicollinearity correlation problem and met the requirement of MANOVA's assumption [41]. Therefore, the data met all One-Way MANOVA's assumptions. After that, the multivariate statistic was tested, and the results are shown in Table 2.

Table 2 shows the multivariate tests and the test of between-subjects effects that the Pillai's Trace between-group = 0.882, F value = 34.329, and Sig = .000*, which Significant value was less than ∝ .05 (Sig < ∝). The H_1 statistical hypothesis was accepted that at least one group of learning management models had Average Achievement and Problem-solving Skills in the DMLI course significantly different from others.

Table 2. Results of the multivariate tests and between-subjects effects

Variance Sources	Multivariate Tests	Value	F	Sig.
Learning Models	Pillai's Trace	0.882	34.329	.00
	Wilks' Lambda	0.179	58.497[a]	.00
	Hotelling's Trace	4.228	89.846	.00
	Roy's Largest Root	4.145	1.803E2[b]	.00

Note. a. Exact statistic, b. The statistic is an upper bound on F that yields a lower bound on the sig level.

Table 3 shows the continuation of testing for between-subjects effects, which are part of the one-way MANOVA statistics' output, and the results of the intergroup tests as part of the Multivariate one-way MANOVA statistical test using IBM's® SPSS® for Windows Version 21 program. Also, Table 3 shows the F value (18.905) of Academic Achievement between groups (S1, S2, and S3) and Sig value of .000*, which confirmed that at least one group of learning management models had Average Achievement in the DMLI course significantly different from others (Sig < ∝). Meanwhile, the F value (179.823) of Problem-solving Skills between groups (S1, S2, and S3) and Sig value of .000* confirmed that at least one group of learning management models had Problem-solving Skills in the DMLI course significantly different from others (Sig < ∝) too.

Finally, a determination was made to run the Scheffé post hoc test comparison of the learning management models/methods (Table 4).

Table 3. The sum of squares and mean square for the dependent variables

Source	Dependent Variable	Sum of Squares	df	Mean Square	F	Sig.
Group	Academic Achievement	3793.152[a]	2	367669.189	18.905	.000*
	Problem-Solving Skills	1132.864[b]	2	566.432	179.823	.000*
Error	Academic Achievement	8728.180	87	100.324		
	Problem-Solving Skills	274.045	87	3.150		
Total	Academic Achievement	247401.478	90			
	Problem-Solving Skills	369065.803	90			

Note. a. R Squared = .303 (Adjusted R Squared = .287), b. R Squared = .805 (Adjusted R Squared = .801)

The results of the Scheffé posthoc test on the group means to determine any source of significant difference are detailed in Table 4 [40]. The results revealed that the:

1. The Flipped PARSER Model group (S2) had a mean = 60.14 and an SD =1.88, which indicates an *academic achievement* score significantly higher than the traditional learning method control group (S1) (mean = 47.83, SD =2.13) and the PBL learning group (S3) (mean = 45.20, SD = 1.32), respectively.
2. The Flipped PARSER Model group (S2) (mean = 68.76, SD = 0.37) had PSS significantly higher than the PBL group (S3) (mean = 63.91, SD = 0.31), and the traditional group (S1) (mean = 60.42, SD = 0.28).

Table 4. The Scheffe Post hoc test comparison of the learning management models/methods

Variables		Traditional (S1)	F-PARSER (S2)	PBL (S3)
Academic Achievement	Mean	47.83	60.14	45.20
Traditional (S1)	47.83	-	-12.31*	2.62
F-PARSER (S2)	60.14	12.31*	-	14.94*
PBL (S3)	45.20	-2.62	-14.94*	-
Problem-solving skills	Mean	60.42	68.76	63.91
Traditional (S1)	60.42	-	-8.35*	-2.21*
F-PARSER (S2)	68.76	8.35*	-	6.13*
PBL (S3)	63.91	2.21*	-6.13*	-

Table 5 shows the overall student teachers' satisfaction in the Flipped PARSER Model (mean = 4.43, SD. = 0.67), which was at the highest level. Moreover, students had the highest satisfaction in all aspects of the Flipped PARSER Model. Also, SD represents the *standard deviation* coupled with the mean to visualize how much difference the variance is within the group is from the mean.

Table 5. Student teacher's satisfaction of S2 students in the F-PARSER Model (*n*=30).

F-PARSER Model Aspects	Mean	SD
Instructor	4.37	0.77
Media & instruction technology	4.43	0.63
Teaching Strategies	4.41	0.65
Objectives & Content	4.46	0.66
Learning Environment	4.41	0.72
Preparation procedures	4.46	0.66
"P" of PARSER	4.36	0.77
"A" of PARSER	4.39	0.63
"R" of PARSER	4.45	0.61
"S" of PARSER	4.36	0.66
"ER" of PARSER	4.50	0.63
Learning Activities	4.46	0.64
Communication & Interaction	4.41	0.74
Measurement & Evaluation	4.42	0.68
Students	4.53	0.57
Overall	4.43	0.67

Note. All variables were reported at the highest level

5 Discussion

The different learning management models/methods had different effects on both academic achievement and problem-solving skills for the student teachers enrolled in one of three *Digital Media and Learning Innovation* courses (Figure 2). As we have seen, *academic achievement* was far higher in the F-PARSER Model group (S2) (mean = 60.14). However, AA was shown to be far behind the F-PARSER Model group (S2) and nearly equal for both the traditional group (mean = 47.83) and the PBL learning group (S3) (mean = 45.20). Therefore, it can be surmised that the FC environment positively affects *academic achievement*.

5.1 Academic achievement

Support for *academic achievement* improvement from using an FC is extensive [42] - [48]. In one such study from Turkey, the authors concluded that the FC significantly influenced the difference between the experimental group's post-test mean scores and that of the control groups for general academic achievement [49]. This was also true for student scores compared to those who attended classes using a classical blended learning method.

In another flipped and blended learning study in which the students were studying bridge engineering, the results revealed that the FC approach was highly effective and that there was a significant difference between the control and experimental groups in terms of students' achievements [42]. However, another study from the US noted that

FCs were very useful in presenting lectures before class, allowing the instructor to engage in hands-on learning activities and more learning by doing with less learning by listening [43].

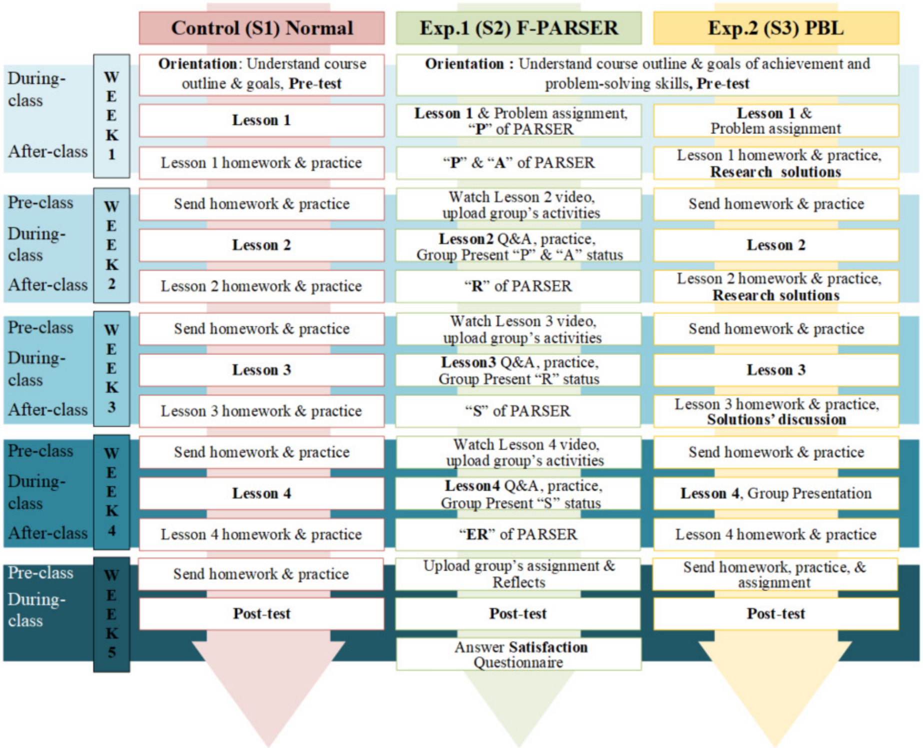

Fig. 2. Main quasi-experiment activities (Source: The authors)

5.2 Problem-solving skills

Concerning the student-teacher *problem-solving skills* and the three methods, the post-test outcome showed that the F-PARSER Model group (S2) was highest (mean = 68.76). However, the post-test results revealed much closer scores between the three methods for *problem-solving skills,* with the PBL (S3) group having a mean = 63.91, followed closely by traditional classroom methods (mean = 60.42).

These high results across all three methods hopefully reflect the importance that Thai education is now placing on student development of PSS as it is now understood that PSSs are an essential factor in the development of 21st-century learning skills (3Rs8Cs), [35],]50] which also include critical thinking and creative thinking skills and their need for a 21st-century workforce [51] - [53].

5.3 Blended learning

Similar results to this study were found from research in South Africa in which the authors merged *blended learning* and FCs to find the best learning methods for their 3rd-year undergraduate students [54]. From the entire semester experiment, the authors reported that once again, teachers should act as facilitators providing direction and correction as required. Also, when ICT resources were combined with online videos, student comprehension of the lesson theory was better understood by class meeting time.

5.4 Flipped classroom

Moreover, the implementation process of FCs has changed over time due to the increase in bandwidth availability, lower costs, and the increasing robustness of the programs and digital devices. However, the basics still apply, such as video for lectures outside the classroom, while application and problem-solving are accomplished in the classroom [19].

Moreover, FCs have also become increasingly important due to the multi-year lockout of students from their traditional classrooms due to the COVID-19 pandemic. Although FCs commonly are associated with classroom activities, this is now being replaced by Zoom sessions as a required alternative due to health requirements and distance measures.

Fortunately, Thailand's Ministry of Education (MOE) has quickly embraced this reality and moved funding into the online space for course development and ICT infrastructure expansion and development. Numerous studies are also exploring how this is affecting student satisfaction with online learning and what are the related issues to its use and success.

However, as a UNESCO report has pointed out, Thailand's distance learning and online learning steps became essential pedagogical methods during the COVID-19 pandemic [1]. Also, various authors have pointed out that digitally based learning platforms in the form of Schoology or Moodle combined with Internet cloud-based FCs and blended learning have become an effective way for teachers to embrace 21st—Century digital innovation and student-centered lectures outside the traditional classroom [55] - [58]. Moreover, the advantages of FC are that 1) the digital sources help students to define their available time and place for learning (anytime/anywhere), 2) the in-class lecture time has been decreased, which then allows teachers to increase their two-way communications ability and the related problem-solving activities, and 3) discussion and problem-solving activities can now be more focused on the learning processes [59].

6 Conclusion

This study set out to develop a flipped learning model to enhance Thai undergraduate student teacher problem-solving skills and academic achievement. After developing and evaluating the F-PARSER Model, it was tested against two other classes teaching the same *Digital Media and Learning Innovation* course using traditional classroom methods and another class using problem-based learning. Results revealed that the F-

PARSER Model was significantly better when academic achievement was compared. However, when problem-solving skills were compared in the same three classes, results were nearly equal for all three models/methods, with the F-PARSER Model slightly better. Furthermore, when student-teacher satisfaction was evaluated at the end of the four-week sessions for the F-PARSER Model, the student teachers were most satisfied with their fellow student teachers, followed by the E & R (evaluation and reflection) part of the model.

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