Bukti Reviewer Pada Heliyon

Untuk melihat bukti proses reviu dapat di lihat pada Link:

https://www2.cloud.editorialmanager.com/heliyon/default2.aspx

Id: samsul_maarif

Pasword: Pemalang@123

Heliyon

COUNTRY

Netherlands

Universities and research institutions in Netherlands

Media Ranking in Netherlands

SUBJECT AREA AND CATEGORY

Multidisciplinary
└ Multidisciplinary

PUBLISHER

Elsevier BV

H-INDEX

69

PUBLICATION TYPE

Journals

ISSN

24058440

COVERAGE

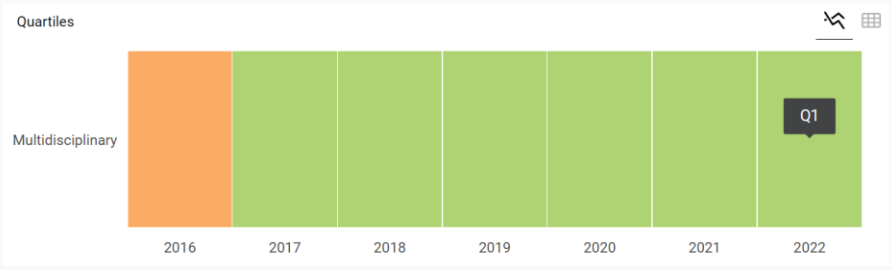
2015-2022

INFORMATION

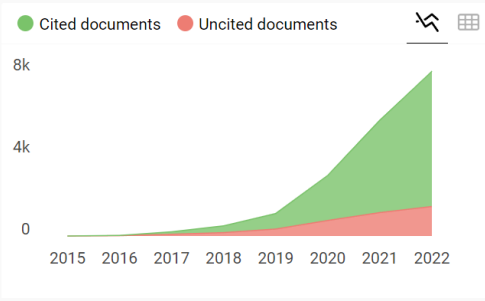
Homepage

How to publish in this journal

c.schulz@cell.com



FIND SIMILAR JOURNALS options



← Show this widget in your own website

Just copy the code below and paste within your html code:

<a href="https://www.scimag

SCImago Graphica

ELSEVIER

Heliyon

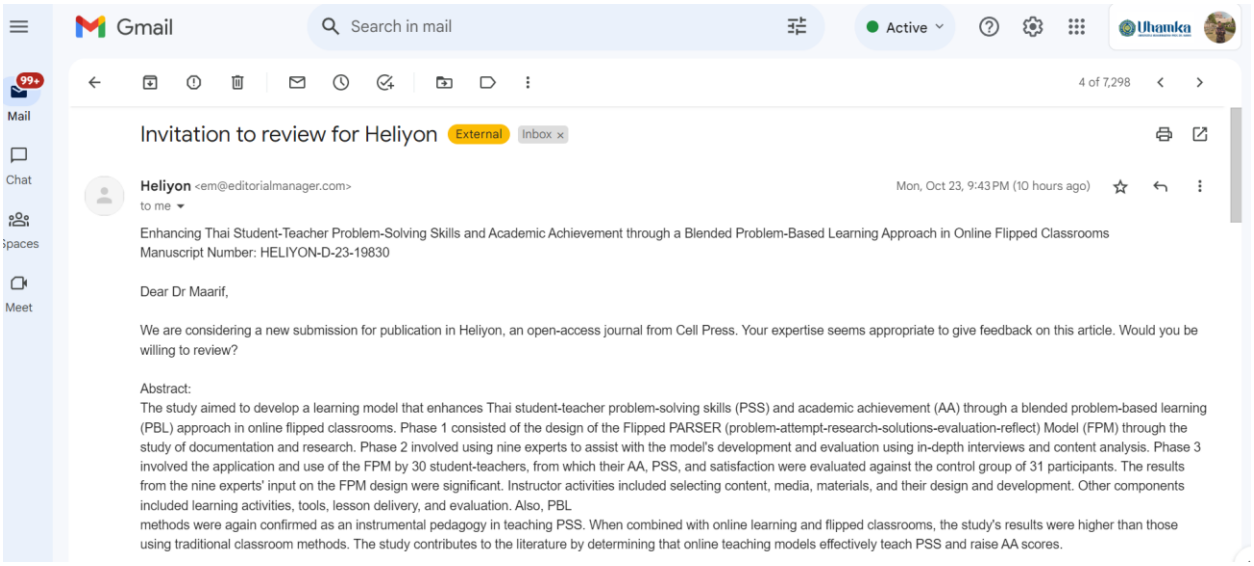
Certificate of Reviewing

Awarded for 1 review in October 2023
presented to

SAMSUL MAARIF

in recognition of the review contributed to the journal

The Editors of Heliyon



Gmail Search in mail Active

4 of 7,298

Invitation to review for Heliyon

External Inbox ×

Heliyon <em@editorialmanager.com> Mon, Oct 23, 9:43 PM (10 hours ago)

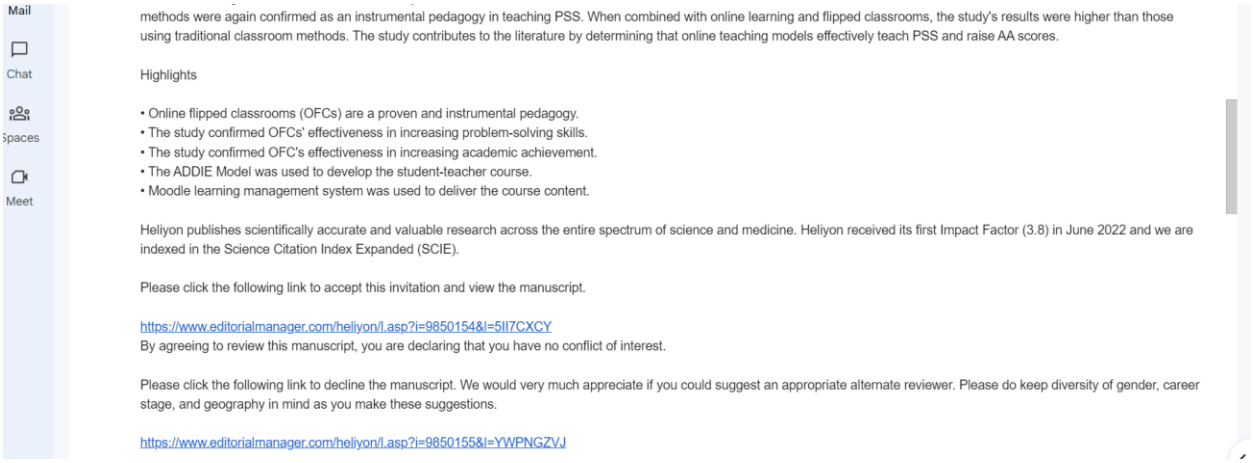
to me

Enhancing Thai Student-Teacher Problem-Solving Skills and Academic Achievement through a Blended Problem-Based Learning Approach in Online Flipped Classrooms
Manuscript Number: HELIYON-D-23-19830

Dear Dr Maarif,

We are considering a new submission for publication in Heliyon, an open-access journal from Cell Press. Your expertise seems appropriate to give feedback on this article. Would you be willing to review?

Abstract:
The study aimed to develop a learning model that enhances Thai student-teacher problem-solving skills (PSS) and academic achievement (AA) through a blended problem-based learning (PBL) approach in online flipped classrooms. Phase 1 consisted of the design of the Flipped PARSER (problem-attempt-research-solutions-evaluation-reflect) Model (FPM) through the study of documentation and research. Phase 2 involved using nine experts to assist with the model's development and evaluation using in-depth interviews and content analysis. Phase 3 involved the application and use of the FPM by 30 student-teachers, from which their AA, PSS, and satisfaction were evaluated against the control group of 31 participants. The results from the nine experts' input on the FPM design were significant. Instructor activities included selecting content, media, materials, and their design and development. Other components included learning activities, tools, lesson delivery, and evaluation. Also, PBL
methods were again confirmed as an instrumental pedagogy in teaching PSS. When combined with online learning and flipped classrooms, the study's results were higher than those using traditional classroom methods. The study contributes to the literature by determining that online teaching models effectively teach PSS and raise AA scores.



methods were again confirmed as an instrumental pedagogy in teaching PSS. When combined with online learning and flipped classrooms, the study's results were higher than those using traditional classroom methods. The study contributes to the literature by determining that online teaching models effectively teach PSS and raise AA scores.

Highlights

- Online flipped classrooms (OFCs) are a proven and instrumental pedagogy.
- The study confirmed OFCs' effectiveness in increasing problem-solving skills.
- The study confirmed OFC's effectiveness in increasing academic achievement.
- The ADDIE Model was used to develop the student-teacher course.
- Moodle learning management system was used to deliver the course content.

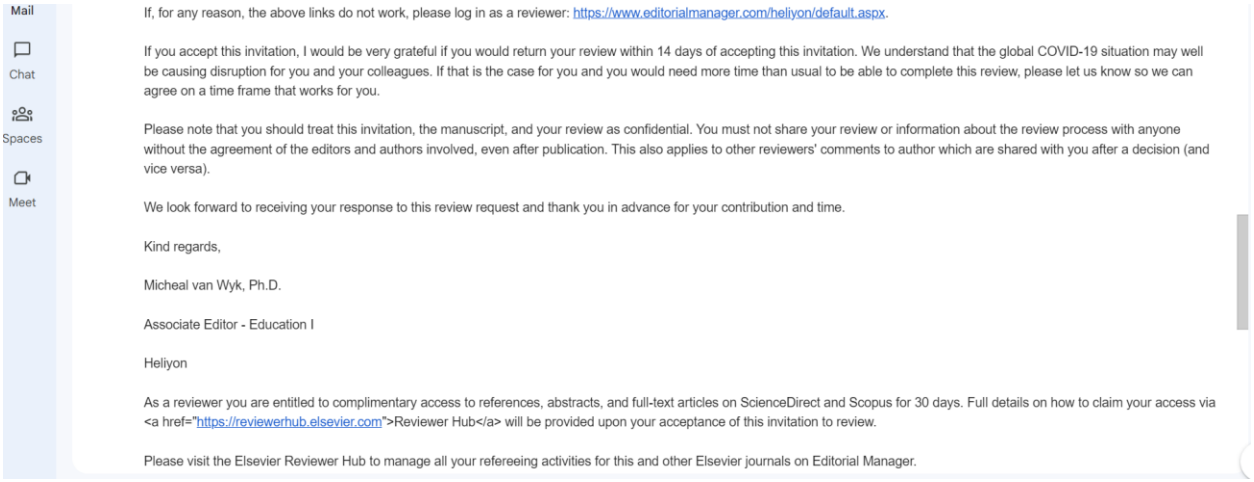
Heliyon publishes scientifically accurate and valuable research across the entire spectrum of science and medicine. Heliyon received its first Impact Factor (3.8) in June 2022 and we are indexed in the Science Citation Index Expanded (SCIE).

Please click the following link to accept this invitation and view the manuscript.

https://www.editorialmanager.com/heliyon/l.asp?i=9850154&l=5II7CXCY
By agreeing to review this manuscript, you are declaring that you have no conflict of interest.

Please click the following link to decline the manuscript. We would very much appreciate if you could suggest an appropriate alternate reviewer. Please do keep diversity of gender, career stage, and geography in mind as you make these suggestions.

https://www.editorialmanager.com/heliyon/l.asp?i=9850155&l=YWPNGZVJ



If, for any reason, the above links do not work, please log in as a reviewer: https://www.editorialmanager.com/heliyon/default.aspx.

If you accept this invitation, I would be very grateful if you would return your review within 14 days of accepting this invitation. We understand that the global COVID-19 situation may well be causing disruption for you and your colleagues. If that is the case for you and you would need more time than usual to be able to complete this review, please let us know so we can agree on a time frame that works for you.

Please note that you should treat this invitation, the manuscript, and your review as confidential. You must not share your review or information about the review process with anyone without the agreement of the editors and authors involved, even after publication. This also applies to other reviewers' comments to author which are shared with you after a decision (and vice versa).

We look forward to receiving your response to this review request and thank you in advance for your contribution and time.

Kind regards,

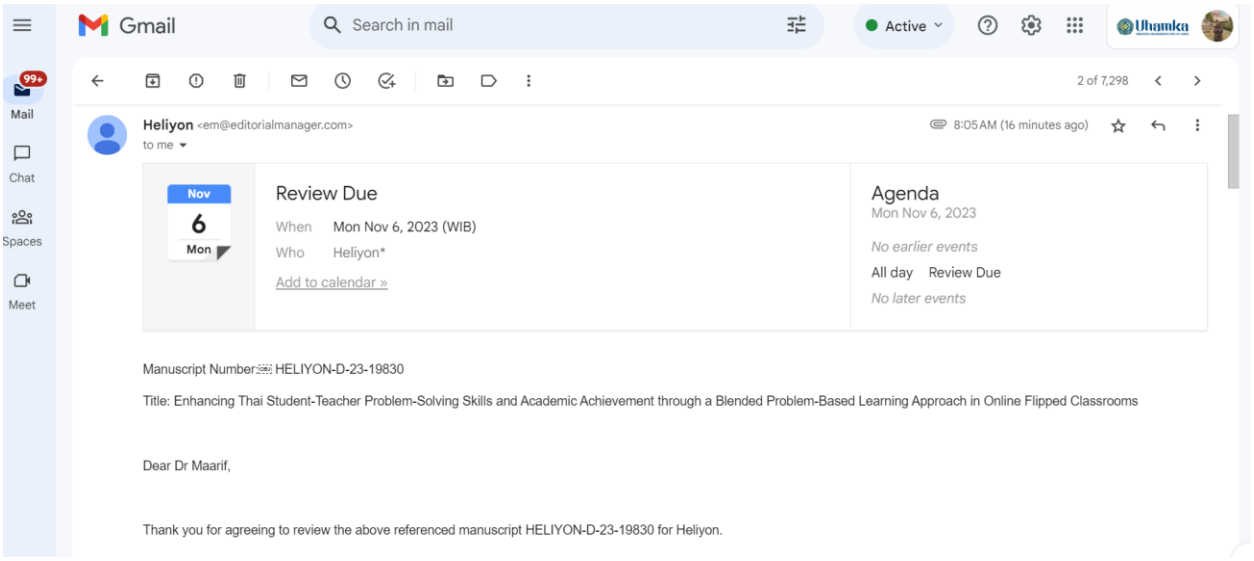
Micheal van Wyk, Ph.D.

Associate Editor - Education I

Heliyon

As a reviewer you are entitled to complimentary access to references, abstracts, and full-text articles on ScienceDirect and Scopus for 30 days. Full details on how to claim your access via Reviewer Hub will be provided upon your acceptance of this invitation to review.

Please visit the Elsevier Reviewer Hub to manage all your refereeing activities for this and other Elsevier journals on Editorial Manager.



Gmail Search in mail Active

Mail Chat Spaces Meet

2 of 7,298

Heliyon <em@editorialmanager.com>
to me

8:05 AM (16 minutes ago)

Nov 6 Mon

Review Due

When Mon Nov 6, 2023 (WIB)
Who Heliyon*

Add to calendar »

Agenda
Mon Nov 6, 2023

No earlier events
All day Review Due
No later events

Manuscript Number: HELIYON-D-23-19830

Title: Enhancing Thai Student-Teacher Problem-Solving Skills and Academic Achievement through a Blended Problem-Based Learning Approach in Online Flipped Classrooms

Dear Dr Maarif,

Thank you for agreeing to review the above referenced manuscript HELIYON-D-23-19830 for Heliyon.

em Heliyon

Samsul Maarif | Logout

Home Main Menu Submit a Manuscript About Help

Action	My Reviewer Number	Manuscript Number	Article Type	Article Title	Date Reviewer Invited	Date Reviewer Agreed	Date Review Due	Days Until Review Due	Editor Name
View Submission View Linked References Similar Articles in MEDLINE Submit Recommendation Send E-mail		HELIYON-D-23-19830	Original Research Article	Enhancing Thai Student-Teacher Problem-Solving Skills and Academic Achievement through a Blended Problem-Based Learning Approach in Online Flipped Classrooms	Oct 23, 2023	Oct 23, 2023	Nov 06, 2023	14	Michea van Wyk, Ph.D.

Reviewer Recommendation and Comments for Manuscript Number HELIYON-D-23-19830

Enhancing Thai Student-Teacher Problem-Solving Skills and Academic Achievement through a Blended Problem-Based Learning Approach in Online Flipped Classrooms

Original Submission
Samsul SMF Maarif, Ph.D

Back Edit Review Print Submit Review to Editorial Office

Recommendation: Invite Revision

Overall Manuscript Rating (1 - 100): 75

Custom Review Question(s):	**Response**
Note: In order to effectively convey your recommendations for improvement to the author(s), and help editors make well-informed and efficient decisions, we ask you to answer the following specific questions about the manuscript and provide additional suggestions where appropriate. 1. Are the objectives and the rationale of the study clearly stated? Please provide suggestions to the author(s) on how to improve the clarity of the objectives and rationale of the study. Please number each suggestion so that author(s) can more easily respond.	Mark as appropriate with an X: Not Applicable [] No and here is how they should be improved [X] Yes, there is no need for improvement [] Provide further comments here: The aim of the research can be seen at a glance, but it has not been written clearly in the introduction, so it is necessary to write down the research aims to be achieved in the research that will be carried out. Furthermore, research gap analysis is not yet visible. So it is important to write research gaps to strengthen the novelty of the research that has been carried out by describing research that has been carried out by other people [illegible] complement or update your research position so that the novelty will be clear
2. If applicable, is the application/theory/method/study reported in sufficient detail to allow for its replicability and/or reproducibility? Please provide suggestions to the author(s) on how to improve the replicability/reproducibility of their study. Please number each suggestion so that the author(s) can more easily respond.	Mark as appropriate with an X: Not Applicable [] No and here is how they should be improved [X] Yes, there is no need for improvement [] Provide further comments here:

Home Main Menu Submit a Manuscript About Help

	This research is the application of the Blended Problem-Based Learning Approach in Online Flipped Classrooms. Online Flipped Classrooms theories and Base Learning problems have been explained clearly and in detail. However, this research tries to develop a Blended Problem-Based with a flipped classroom which is not yet supported by theories that specifically discuss the relationship between the two. So it is necessary to add a sub for the literature review which discusses the relationship between PBL and FCs.
3. If applicable, are statistical analyses, controls, sampling mechanism, and statistical reporting (e.g., P-values, CIs, effect sizes) appropriate and well described? Please clearly indicate if the manuscript requires additional peer review by a statistician. Kindly provide suggestions to the author(s) on how to improve the statistical analyses, controls, sampling mechanism, or statistical reporting. Please number each suggestion so that the author(s) can more easily respond.	Mark as appropriate with an X: Not Applicable [] No and here is how they should be improved [X] Yes, there is no need for improvement [] Provide further comments here: This research uses a mix-method, but the type of mix-method is not clearly written, whether it uses explanatory/exploratory/combine. In each part the methodology is also unclear, in the sense of what method to use for quantitative? And what method do you use for qualitative ones? In quantitative research, data results are obtained from experiments with data analysis using MANOVA. The data analyzed has illustrated the results of the experiment. However, the research hypothesis for the experimental part is not clear. The sample size has been written clearly and the results of data analysis have been written clearly.
4. If applicable, are the existing tables and/or figures complete and acceptable for publication? Please provide specific suggestions for improvements, removals, or additions of figures or tables. Please number each suggestion so that the author(s) can more easily respond.	Mark as appropriate with an X: Not Applicable [] No and here is how they should be improved [X] Yes, there is no need for improvement [] Provide further comments here: Overall, the use of tables and figures is appropriate and readable. However, there are several figures and tables that need to be revised, namely: 1. In "figure 3. Online flipped classroom technologies and environments." The combination of background color and writing is biased so that the writing is less legible. The size of the writing on the image is also too small so it is not visible. 2. In "table 6. Statistics for preliminary examination of the agreement." Does not match the table in the journal template and is different from other tables. 3. In "table 8. Mean, SD and overall student-teacher FPM satisfaction are classified by overall and individual aspects.." Does not match the table in the journal template and is different from other tables.
5. If applicable, are the interpretation of results and study conclusions supported by the data? Please provide suggestions (if needed) to the author(s) on how to improve, tone down, or expand the study interpretations/conclusions. Please number each suggestion so that the author(s) can more easily respond.	Mark as appropriate with an X: Not Applicable [] No and here is how they should be improved [X] Yes, there is no need for improvement [] Provide further comments here: Overall the results and conclusions are supported by the data, however, in some parts it is necessary to add data to the results section, including: 1. Page 12, line 47: Complete the average result data: pre-test, formative assessment, and summative assessment. 2. Page 13, line 32: It is necessary to explain how long the learning process takes and what material is taught Next, in the discussion section, there are several things that need to be improved, including: 1. The discussion section should contain phenomena from the research results for further discussion by comparing the results of the meeting with previous research. So, the discussion section no longer discusses the problems that will be faced but focuses on the findings from research that has been carried out and compared with the results of previous studies to see whether they strengthen or falsify them. 2. Page 17, line 31: This is the discussion section. It should not only display quantitative data from experimental results. However, the experimental data explains why it is significant, what factors cause it and compares it with the results of previous studies. 3. Page 17, line 37: The finding that "research into the application of FAM shows that BL is very effective when used with FC" should be explored with a qualitative study in accordance with the method chosen, namely mixed methods

6. Have the authors clearly emphasized the strengths of their study/theory/methods/argument? Please provide suggestions to the author(s) on how to better emphasize the strengths of their study. Please number each suggestion so that the author(s) can more easily respond.	Mark as appropriate with an X: Not Applicable [] No and here is how they should be improved [X] Yes, there is no need for improvement [] Provide further comments here: The strengths of the study have been written clearly. However, the discussion section needs improvement, including: 1. The discussion section should contain phenomena from the research results for further discussion by comparing the results of the meeting with previous research. So, the discussion section no longer discusses the problems faced but focuses on the findings from research that has been carried out and compared with the results of previous studies to see whether they strengthen or falsify them. 2. Page 17, line 31: This is the discussion section. It should not only display quantitative data from experimental results. However, the experimental data explains why it is significant, what factors cause it and compares it with the results of previous studies. 3. Page 17, line 37: The finding that "study's FAM application showed that BL is highly effective when used with an FC" should be explored with a qualitative study in accordance with the method chosen, namely the mix method
7. Have the authors clearly stated the limitations of their study/theory/methods/argument? Please list the limitations that the author(s) need to add or emphasize. Please number each limitation so that author(s) can more easily respond.	Mark as appropriate with an X: Not Applicable [] No and here is how they should be improved [X] Yes, there is no need for improvement [] Provide further comments here: Research limitations have been written clearly. However, it is necessary to add to the shortcomings of this research, namely that the research method is not clear with the type of mix-method, namely exploratory, exploratory or merge/simultaneous.
8. Is the manuscript's structure, flow, or writing acceptable for publication? (Think for example of the addition of subheadings, shortening of text, reorganization of sections, or moving details from one section to another) Please provide suggestions to the author(s) on how to improve the manuscript structure and flow. Please number each suggestion so that author(s) can more easily respond.	Mark as appropriate with an X: Not Applicable [] No and here is how they should be improved [] Yes, there is no need for improvement [X] Provide further comments here: The manuscript writing structure is in accordance with the template and accepted for

8. Is the manuscript's structure, flow, or writing acceptable for publication? (Think for example of the addition of subheadings, shortening of text, reorganization of sections, or moving details from one section to another) Please provide suggestions to the author(s) on how to improve the manuscript structure and flow. Please number each suggestion so that author(s) can more easily respond.	Mark as appropriate with an X: Not Applicable [] No and here is how they should be improved [] Yes, there is no need for improvement [X] Provide further comments here: The manuscript writing structure is in accordance with the template and accepted for publication

9. Could the manuscript benefit from language editing?	No
Do you want to join the Heliyon Advisory Board? Learn more about the Advisory Board Member role: Guide for Referees: Heliyon (cell.com)	Yes

Reviewer Comments to Author

Several points need improvement, including:

1. Abstract
- Page 1, Lines 2-5: The learning objective is to develop a learning model, namely blended problem-based learning (PBL) approach in online flipped classrooms. If seen from the theoretical basis, the flipped classroom is one part of blended learning, so the author must be able to explain this to strengthen the philosophical reasons for the model development that has been carried out.
- Page 1, Lines 10-12: It is necessary to clarify what model this "traditional classroom method" uses, because every learning carried out in the classroom must use a model even if we justify it as traditional learning
- Page 1, Line 18: At the application stage, it is necessary to explain the method used, what is the experiment?

2. Introduction
- Page 1, line 35: Data needs to be displayed, what percentage of schools in Thailand have implemented learning using an online learning model. This strengthens the argument for the importance of online learning in Thailand
- Page 1, line 41: What is the flipped classroom as a solution? What is the problem that needs to be strengthened? What is the FC's position on this problem? It is necessary to reveal the results of research that has applied FC to the problems you have found so that it strengthens the argument that FC is a solution in learning.
-Page 3, line 4: Research gap analysis is not yet visible. So it is important to write research gaps to strengthen the novelty of the research that has been carried out by describing research that has been carried out by other people, then complement or update your research position so that the novelty will be clear
-Line 46: There needs to be strong data to provide a statement that FCs are like PBL. It can start from a philosophical basis or the results of previous studies which reveal that FCs focuses on learning that

Reviewer Comments to Author

Several points need improvement, including:

1. Abstract
- Page 1, Lines 2-5: The learning objective is to develop a learning model, namely blended problem-based learning (PBL) approach in online flipped classrooms. If seen from the theoretical basis, the flipped classroom is one part of blended learning, so the author must be able to explain this to strengthen the philosophical reasons for the model development that has been carried out.
- Page 1, Lines 10-12: It is necessary to clarify what model this "traditional classroom method" uses, because every learning carried out in the classroom must use a model even if we justify it as traditional learning
- Page 1, Line 18: At the application stage, it is necessary to explain the method used, what is the experiment?

2. Introduction
- Page 1, line 35: Data needs to be displayed, what percentage of schools in Thailand have implemented learning using an online learning model. This strengthens the argument for the importance of online learning in Thailand
- Page 1, line 41: What is the flipped classroom as a solution? What is the problem that needs to be strengthened? What is the FC's position on this problem? It is necessary to reveal the results of research that has applied FC to the problems you have found so that it strengthens the argument that FC is a solution in learning.
-Page 3, line 4: Research gap analysis is not yet visible. So it is important to write research gaps to strengthen the novelty of the research that has been carried out by describing research that has been carried out by other people, then complement or update your research position so that the novelty will be clear
-Line 46: There needs to be strong data to provide a statement that FCs are like PBL. It can start from a philosophical basis or the results of previous studies which reveal that FCs focuses on learning that emphasizes problem solving.

3. Literature Review
-page 6, line 5: It is necessary to add a sub for the review literature which discusses the relationship between PBL and FCs.
-Page 7, line 27: Research gap analysis not yet visible. So it is important to write research gaps to strengthen the novelty of the research that has been carried out by describing research that has been carried out by other people, then complement or update your research position so that the novelty will be clear.
-page 7, line 43: Need to add research questions as objectives to be achieved from the research that has been carried out

4. Method

- The method used is not yet clear, the research uses a mixed method but whether it is exploratory, exploratory or combined is not written. The methodology is similar to Research & Development, but the researcher decided to use the Mix Method. The mix-method used is also not clear, what method is used in the quantitative part? And in the qualitative part, what method do you use?
-Lines 50-52: It is necessary to clarify the mix method used, whether exploratory, exploratory or combined. This is important to strengthen the methodology so that the research direction can be seen as a whole.

-Lines 50-52: It is also necessary to explain in diagram form the steps of the quantitative and qualitative methodology. State the purpose for each. Quantitative methodology uses what? What's the aim? What do you use for qualitative methodology? What's the aim?
-Lines 57-58: If we compare the methodologies in the abstract section, the methodology tends to be research & development, but the methodology section uses Mix-method. This requires a detailed explanation. Because the Steps in the methodology lead to R&D. So it is necessary to clarify the purpose of each method in the proposed mix method and align it in the abstract section.
- page 8, Line 12: What type do you need to explain? What is explanatory? Is it exploratory? What is combine? And it needs to be clarified which method to use for qualitative and what method to use for quantitative?
-Page 8, Line 22: These phases from phases 1-3 are the steps of development research. So, we have to clarify what this has to do with the mix method being run
-Page 8, line 47: Need to explain how long the evaluation process has taken and need to explain the evaluation instruments used
-Page 8, line 57: Need to explain the indicators of the instruments used
-Page 9, line 5: It is necessary to describe the indicators of the evaluation instrument carried out by the expert
-Page 9, line 37: It uses research development methodology. What is the relationship with the method that has been decided, namely the mix method?
Page 10, line 1: In figure 3, the writing on the image is too small and the color combination with the writing is a bit biased so it is less legible
-Page 10, line 21: Needs to be clarified for AA instruments. Because in the article only a questionnaire with multiple choices is written. It is necessary to explain the indicators used in forming the AA instrument so that it is clear what is being aimed at.
-Page 10, line 37: Need to explain the indicators of the instrument used
-Page 10, line 45: Collecting data and data analysis only focuses on experimental data from the model being developed. Meanwhile, data collection and analysis for the model development process are not explained in detail
-Page 10, line 53: The type of experimental design carried out is not yet visible and clear
-Page 12, line 48: Complete the average result data: pre-test, formative assessment, and summative assessment.

3

5. Result

-Page 12, line 47: Complete the average result data: pre-test, formative assessment, and summative assessment.
-Page 13, line 32: It is necessary to explain how long the learning process takes and what material is taught
- In "tables 6 and 8." Does not match the table in the journal template and is different from other tables.

6. Discussions

- The discussion section should contain phenomena from the research results for further discussion by comparing the results of the meeting with previous research. So, the discussion section no longer discusses the problems faced but focuses on the findings from research that has been carried out and compared with the results of previous studies to see whether they strengthen or falsify them.
-Page 17, line 31: This is the discussion section. It should not only display quantitative data from experimental results. However, the experimental data explains why it is significant, what factors cause it and compares it with the results of previous studies.
-Page 17, line 37: The finding that "study's FAM application showed that BL is highly effective when used with an FC" should be explored with a qualitative study in accordance with the method chosen, namely the mix method

7. Conclussion

-page 17, line 51: Need to add implications of the research that has been carried out

8. Limitation
It is necessary to add to the shortcomings of this research, namely that the research method is not clear with the type of mix-method, namely exploratory, exploratory or merge/simultaneous.

9. References

Page 18, line 61: Adjust to the rules for writing references, it would be better to use references in the form of journals

3

Transfer Authorization	Response
If this submission is transferred to another publication, do we have your consent to include your identifying information?	Yes
If this submission is transferred to another publication, do we have your consent to include your review?	Yes

Attachments:

Action	Description	File Name	Size	Last Modified
Download	Review result	HELIYON-D-23-19830_Rev.pdf	1.2 MB	Oct 24, 2023

3

Back | Edit Review | Print | Submit Review to Editorial Office

em Heliyon

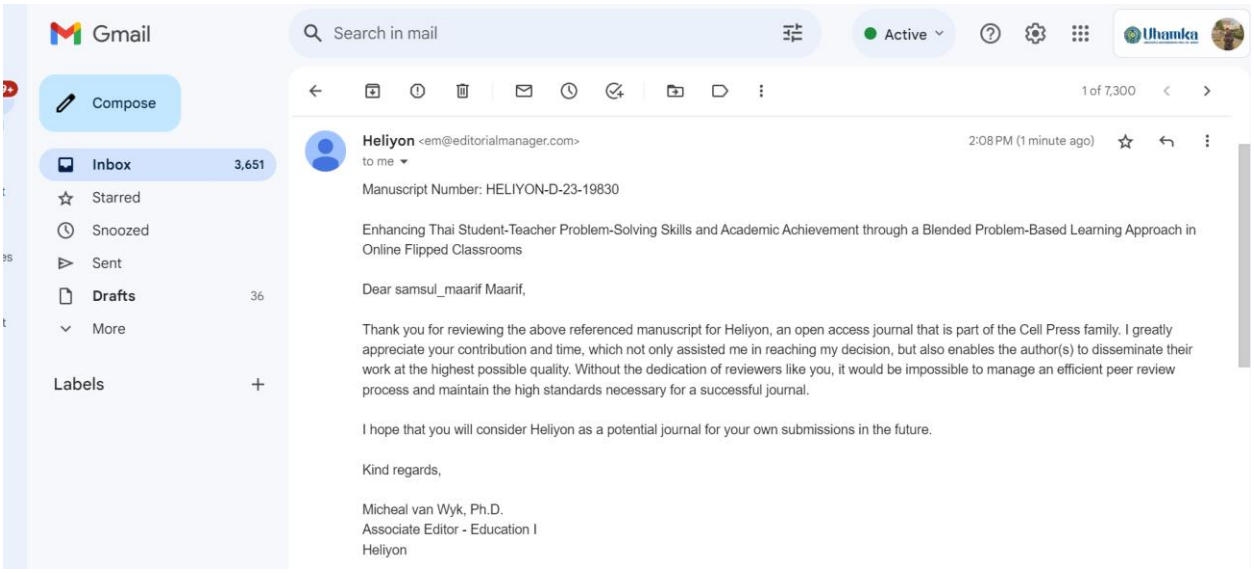
Samsul Maarif | Logout

Home | Main Menu | Submit a Manuscript | About | Help

Review Thank You

Thank you for reviewing Manuscript Number HELIYON-D-23-19830.

Return to Main Menu


Gmail
Search in mail
Active
Compose
Inbox 3,651
Starred
Snoozed
Sent
Drafts 36
More
Labels
1 of 7,300
Heliyon <em@editorialmanager.com>
to me
2:08 PM (1 minute ago)
Manuscript Number: HELIYON-D-23-19830
Enhancing Thai Student-Teacher Problem-Solving Skills and Academic Achievement through a Blended Problem-Based Learning Approach in Online Flipped Classrooms
Dear samsul_maarif Maarif,
Thank you for reviewing the above referenced manuscript for Heliyon, an open access journal that is part of the Cell Press family. I greatly appreciate your contribution and time, which not only assisted me in reaching my decision, but also enables the author(s) to disseminate their work at the highest possible quality. Without the dedication of reviewers like you, it would be impossible to manage an efficient peer review process and maintain the high standards necessary for a successful journal.
I hope that you will consider Heliyon as a potential journal for your own submissions in the future.
Kind regards,
Micheal van Wyk, Ph.D.
Associate Editor - Education I
Heliyon

Artikel Hasil Reviu

Heliyon

Enhancing Thai Student-Teacher Problem-Solving Skills and Academic Achievement through a Blended Problem-Based Learning Approach in Online Flipped Classrooms

--Manuscript Draft--

Manuscript Number:	HELIYON-D-23-19830
Article Type:	Original Research Article
Section/Category:	Social Sciences
Keywords:	academic achievement; blended learning; online flipped classroom; problem-solving skills; student-teachers; Thailand
Abstract:	The study aimed to develop a learning model that enhances Thai student-teacher problem-solving skills (PSS) and academic achievement (AA) through a blended problem-based learning (PBL) approach in online flipped classrooms. Phase 1 consisted of the design of the Flipped PARSER (problem-attempt-research-solutions-evaluation-reflect) Model (FPM) through the study of documentation and research. Phase 2 involved using nine experts to assist with the model's development and evaluation using in-depth interviews and content analysis. Phase 3 involved the application and use of the FPM by 30 student-teachers, from which their AA, PSS, and satisfaction were evaluated against the control group of 31 participants. The results from the nine experts' input on the FPM design were significant. Instructor activities included selecting content, media, materials, and their design and development. Other components included learning activities, tools, lesson delivery, and evaluation. Also, PBL methods were again confirmed as an instrumental pedagogy in teaching PSS. When combined with online learning and flipped classrooms, the study's results were higher than those using traditional classroom methods. The study contributes to the literature by determining that online teaching models effectively teach PSS and raise AA scores. Highlights • Online flipped classrooms (OFCs) are a proven and instrumental pedagogy. • The study confirmed OFCs' effectiveness in increasing problem-solving skills. • The study confirmed OFC's effectiveness in increasing academic achievement. • The ADDIE Model was used to develop the student-teacher course. • Moodle learning management system was used to deliver the course content.

Commented [SM1]: The learning objective is to develop a learning model, namely a blended problem-based learning (PBL) approach in an online flipped classroom. If seen from the theoretical basis of the flipped class, it is one part of blended learning, so the author must be able to explain this to strengthen the philosophical reasons for the development model that has been carried out.

Commented [SM2]: It is necessary to clarify what model this "traditional classroom method" uses, because every learning carried out in the classroom must use a model even if we justify it as traditional learning.

Enhancing Thai Student-Teacher Problem-Solving Skills and Academic Achievement through a Blended Problem-Based Learning Approach in Online Flipped Classrooms

Paitoon Pimdee[1], Aukkapong Sukkamart[2*], Thiyaporn Kantathanawat[3], Punnee Leekitchwatana[4] and Cherisa Nantha[5]

[1] School of Industrial Education and Technology, King Mongkut's Institute of Technology Ladkrabang (KMITL), Bangkok, Thailand
E-mail: paitoon.pi@kmitl.ac.th, ORCID: 0000-0002-3724-2885
[2] School of Industrial Education and Technology, King Mongkut's Institute of Technology Ladkrabang (KMITL), Bangkok, Thailand
E-mail: draukkapongkmitl@gmail.com, ORCID: 0000-0002-1234-4033
[3] School of Industrial Education and Technology, King Mongkut's Institute of Technology Ladkrabang (KMITL), Bangkok, Thailand
E-mail: thiyaporn.ka@kmitl.ac.th, ORCID: 0000-0002-4436-8806
[4] School of Industrial Education and Technology, King Mongkut's Institute of Technology Ladkrabang (KMITL), Bangkok, Thailand
E-mail: punnee.le@kmitl.ac.th, ORCID: 0000-0002-1355-2811
[5] School of Industrial Education and Technology, King Mongkut's Institute of Technology Ladkrabang (KMITL), Bangkok, Thailand
E-mail: happycherisa@gmail.com, ORCID: 0000-0002-3225-3155
* Correspondence: draukkapongkmitl@gmail.com

Highlights

- Online flipped classrooms (OFCs) are a proven and instrumental pedagogy.
- The study confirmed OFCs' effectiveness in increasing problem-solving skills.
- The study confirmed OFC's effectiveness in increasing academic achievement.
- The ADDIE Model was used to develop the student-teacher course.
- Moodle learning management system was used to deliver the course content.

Abstract

The study aimed to develop a learning model that enhances Thai student-teacher problem-solving skills (PSS) and academic achievement (AA) through a blended problem-based learning (PBL) approach in online flipped classrooms. Phase 1 consisted of the design of the Flipped PARSER (problem-attempt-research-solutions-evaluation-reflect) Model (FPM) through the study of documentation and research. Phase 2 involved using nine experts to assist with the model's development and evaluation using in-depth interviews and content analysis. Phase 3 involved the application and use of the FPM by 30 student-teachers, from which their AA, PSS, and satisfaction were evaluated against the control group of 31 participants. The results from the nine experts' input on the FPM design were significant. Instructor activities included selecting content, media, materials, and their design and development. Other components included learning activities, tools, lesson delivery, and evaluation. Also, PBL methods were again confirmed as an instrumental pedagogy in teaching PSS. When combined with online learning and flipped classrooms, the study's results were higher than those using traditional classroom methods. The study contributes to the literature by determining that online teaching models effectively teach PSS and raise AA scores.

Keywords: academic achievement, blended learning, online flipped classroom, problem-solving skills, student-teachers, Thailand.

1. Introduction

Recent educational studies have explored new learning models to overcome the challenges posed by the multi-year COVID-19 pandemic [1]. In Thailand, the education sector has adopted a *New Normal*, with traditional classrooms being replaced by online courses accessible via digital devices like smartphones [2]. However, the transition to online learning could have been smoother, with many learners unhappy with the change and educators unprepared to deliver content online [3]. There are documented challenges related to rural learners' academic achievement, access to information communications technology (ICT), and reliable broadband connections [4-5].

Fortunately, the flipped classroom model has been proven to be a cost-effective solution for online learning [6], enabling learners to choose when, where, and how they learn. This allows FC instructors to focus on problem-solving exercises and complex content [7], leading to the emergence of the role of "knowledge facilitators" for teachers [4]. Personalized and student-centered learning becomes possible [2], [8-10] when learners return to the classroom.

FCs and models like PBL are seen as a classroom engines to achieve specific goals [11]. Additionally, under the social distancing requirements and the need for online education during the pandemic, FCs and blended became even more widespread [12-13]. Researchers have found that students who spend time in FCs can master their learning, especially when combined with other pedagogies like BL and PBL, allowing learners to choose their content [14-15]. Teachers become knowledge facilitators in FC settings, leading to in-class discussions and activities with relevant materials, focusing on student-centered learning [16].

FCs use blended learning to achieve specific educational goals, especially in the context of social distancing requirements during the pandemic [11-13]. Students who spend time in FCs receive maximum value for their time and can master their learning, especially when combined with other pedagogies such as PBL [14-15]. Teachers coach and facilitate knowledge in FC settings, allowing active and collaborative student-centered learning [16]. Out-class activities are flipped into self-paced active learning using online materials, with

Commented [SM3]: The learning objective is to develop a learning model, namely a blended problem-based learning (PBL) approach in an online flipped classroom. If seen from the theoretical basis of the flipped class, it is one part of blended learning, so the author must be able to explain this to strengthen the philosophical reasons for the development model that has been carried out.

Commented [SM4]: At the application stage, it is necessary to explain the method used, what is the experiment?

Commented [SM5]: It is necessary to clarify what model this "traditional classroom method" uses, because every learning carried out in the classroom must use a model even if we justify it as traditional learning.

Commented [SM6]: Data needs to be displayed, what percentage of schools in Thailand have implemented learning using an online learning model. This strengthens the argument for the importance of online learning in Thailand

Commented [SM7]: What is the flipped classroom as a solution? What is the problem that needs to be strengthened? What is the FC's position on this problem? It is necessary to reveal the results of research that has applied FC to the problems you have found so that it strengthens the argument that FC is a solution in learning.

Commented [SM8]: There needs to be strong data to provide a statement that FCs are like PBL. It can start from a philosophical basis or the results of previous studies which reveal that FCs focuses on learning that emphasizes problem solving.

LMSs (learning management systems) managing material use, communications, and assessment [17]. Stakeholders have reported positive attitudes toward FC experiences, including peer interaction, learning materials, and student assessment [18-19].

PBL is an effective pedagogy for teaching 21st-century skills such as problem-solving, especially when combined with SDL [20]. PBL lessons can be implemented in various ways, such as using the European Maastricht *seven jump* process [21-22] (Fig. 1).

Commented [SM9]: Research gap analysis is not yet visible. So it is important to write research gaps to strengthen the novelty of the research that has been carried out by describing research that has been carried out by other people, then complement or update your research position so that the novelty will be clear

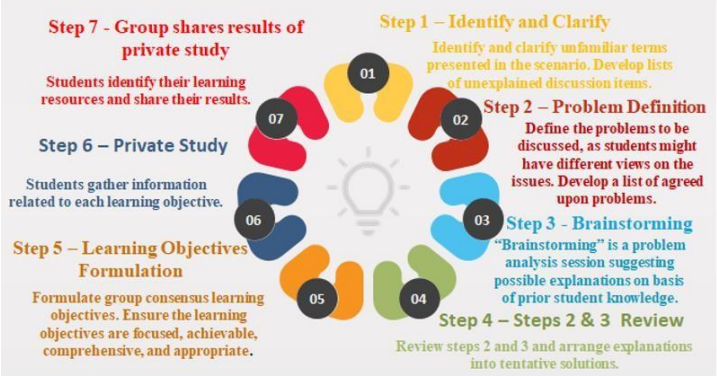


Fig. 1. The Maastricht 7-step PBL learning method.
Source: Adapted from Wood [22].

2. Literature Review

This section contains an overview of the theory and literature on using online flipped classrooms, problem-based learning, blended learning, problem-solving skills, and academic achievement.

2.1. Online Flipped Classrooms (OFC)

In recent years, the online flipped classroom (OFC) has become increasingly popular as an educational pedagogy for promoting student motivation and online learning [23]. OFCs move the lecture process outside the classroom, and its core idea has been expanded and explored with newer mediums, platforms, and devices. In Thailand, OFCs have effectively taught STEAM classes, computational thinking, analytical thinking, 21st-century information literacy, and online active learning [25-29]. OFCs are frequently combined with blended learning as new models for both in-class and out-of-class teaching (Table 1 and Fig. 2). Flipped classroom use has increased dramatically in recent years due to the social distancing requirements established by most educational institutions during the global COVID-19 pandemic [30-31].

OFCs use video clips viewed by students from home on digital devices, with the option of cloud-based platforms like YouTube or LMSs such as Schoology or Moodle Cloud. Classroom time is used for reviewing and practicing the flipped homework/lecture, replacing traditional in-class lectures.

Luo et al. [32] divided out-class activities into pre-class and post-class, while Tomas et al. [33] separated teacher activities into preparation for out-class and in-class materials. Talbert [34] suggests inverting Bloom's Model for flipped-classroom environments, and the

authors' adapted Bloom pyramid [35] has students develop lower-level skills at home and higher-order thinking skills through in-class activities (Fig. 2).

Table 1.
Flipped in-class and out-class activity discussions.

Activities	Bergman and Sams [8]	Flores et al. [18]	Uskokovic [13]	Tomas et al. [33]	Luo et al. [32]
In-class	✓	✓	✓	✓	✓
Out-class	✓	✓	✓	✓	✓
Pre-class	✓	✓	✓		✓
Post-class					✓

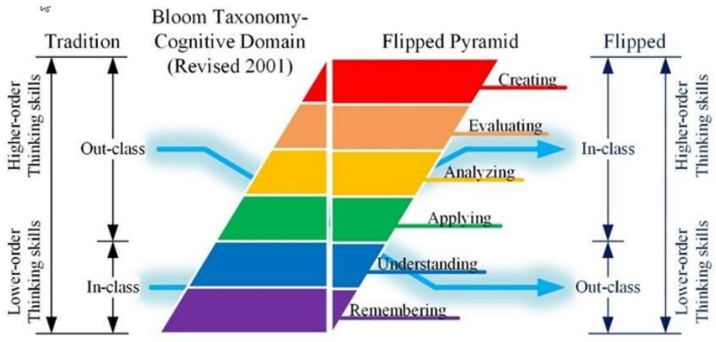


Fig. 2. Bloom's revised taxonomy - cognitive domain (revised 2001) - the flipped classroom.
Sources: [34-35].

2.2. Problem-Based Learning (PBL)

Problem-based learning involves several steps: problem identification, definition, investigation, reflection, evaluation, application, objective definition, data collection, summarization, and synthesis [36-39]. Different researchers have suggested varying numbers of steps, with some concluding that only four steps are necessary: problem definition, research, implementation, and reflection and evaluation [40]. PBL challenges students to cope with real-life problems and motivates them to apply their knowledge to future work [41]. However, in Qatar, Al Said et al. [42] identified math teachers' difficulties in implementing PBL in their classrooms, citing a lack of confidence, issues with developing student collaboration abilities, homework issues, and limitations from school and peer support. These findings suggest a need for new forms of problems and approaches to resolving them, such as more direct instruction and greater teacher autonomy in undertaking PBL.

Other researchers have focused on PBL's implementation step in which students use their research to solve real-world problems [40],[43]. However, many others have detailed how problem identification and definition are essential elements in PBL activities [36],[38-39],[44]. Contemporary Thai scholars such as Chinchua et al. [9] have seen the importance of PBL and its use for increasing programming self-efficacy (PSE) through gamification.

Elsewhere, in addition to BL methods and FCs, other studies have pointed to their use in PBL [45], in online PBL in marketing research courses [7], teaching algebra [46], teaching digital photography [47], increasing PSS through educational games that teach computer programming courses [48], and robotics programming [49].

Kraiklang et al. [50] also reported PBL to use success with Thai 9th graders in science problem-solving abilities. In contrast, Panjan [51] reported success with PBL when used in STEM promotion workshops using computational thinking and robotics for pre-engineering students.

Therefore, from the lengthy and detailed review of PBL literature, the authors concluded that there were ten core problem-solving skills development procedures. These were 1) problem identification, 2) problem clarification, 3) problem analysis and problem solutions using prior knowledge, 4) investigation and research of new knowledge, 5) objective definition, 6) implementation, 7) data collection and summarization, 8) data synthesis, 9) reflection and evaluation, and 10) application (Table 2).

Table 2.
Problem-based learning procedures overview.

PBL Learning Steps	**Guilford** [37]	**Weir** [38]	**Schmidt** [39]	**Woods** [40]	**Wood** [22]	**Maudsley** [43]	**Blayney** [44]
Problem identification	✓	✓	✓				✓
Problem clarification	✓	✓	✓	✓	✓	✓	✓
Problem analysis/solutions			✓				
Investigation and research	✓	✓	✓	✓	✓	✓	✓
Objective definition			✓			✓	✓
Implementation				✓		✓	
Data collection and summarization			✓				
Data synthesis			✓				
Reflection and evaluation	✓	✓		✓	✓	✓	✓
Application	✓				✓		

2.3. Blended Learning (BL)

According to Bizami et al. [52], BL has become a commonly accepted method for integrating face-to-face classroom learning with online learning, especially in higher education in recent years, due to Internet accessibility and more affordable ICT systems and digital devices as smartphones [53]. These points are consistent with a study from Sothayapetch and Lavonen [54], who found BL compelling when combined with online teaching for Thai and Finn primary school science students. It was also pointed out that all

the teachers surveyed felt that educational technology should be used as much as possible for the learning environment to be effective.

Numerous studies have also proven blended learning effective in raising student scores and increasing academic achievement, especially when combined with Internet/Web-related technologies [55], such as Moodle [56-57].

Commented [SM10]:
It is necessary to add a sub to the literature review which discusses the relationship between PBL and FCs.

2.4. Problem-Solving Skills (PSS)

Schmidt and Moust [58] presented a seven-step process for learning management using problem-based methods. This involves understanding the terms and concepts in the problem, accurately capturing critical information, analyzing the problem through group brainstorming, finding explanations, setting learning objectives, searching for information from various sources, applying knowledge to analyze and correct hypotheses, and summarizing conclusions and principles.

Furthermore, Table 3 presents an overview of multiple PSS studies and which factors were the main themes in each. The authors' evaluation concluded that there were four predominant themes in the PSS literature [59-62]. These were analyzing, researching, decision-making, and planning & practice skills.

Table 3.
PSS literature review evaluation.

PSS	Indeed Editorial Team [59]	Organization for Economic Cooperation and Development [60]	Hapha [61]	Kruthgat [62]
Active listening	✓			
Analyzing	✓	✓	✓	✓
Researching	✓	✓	✓	✓
Creativity	✓	✓		
Communications	✓			
Dependability	✓			
Decision making	✓	✓	✓	✓
Teamwork	✓		✓	
Presentation			✓	
Application			✓	
Planning & Practice			✓	✓
Evaluation				✓

2.5. Academic Achievement (AA)

In the context of Thai academic achievement, incorporating problem-based learning (PBL) and blended learning can be effective strategies for improving student outcomes. Banic and Gamboa [21] demonstrated that combining PBL with 3D design techniques in computer science courses can lead to higher academic achievement than traditional teaching methods. This highlights the importance of using innovative teaching methods and technology to engage students and facilitate their learning.

Moreover, the study conducted by Adebola and Ademola [63] in Nigeria showed that the teaching materials and learning environment also play a significant role in academic achievement, particularly in mathematics. This suggests that creating a supportive learning

environment with appropriate resources and innovative teaching methods can positively impact student performance.

Blended learning, which combines traditional face-to-face instruction with online learning, can also enhance student achievement. Blended learning provides students more flexibility in terms of time and place of learning and can facilitate more personalized learning experiences [29].

Therefore, incorporating PBL and blended learning in the Thai educational system can be a promising way to address the challenges of low academic achievement and improve student outcomes [60]. By leveraging innovative teaching methods and technology, providing appropriate resources and support, and creating a flexible and engaging learning environment, students can be empowered to achieve their full potential.

2.6. Research Problem

In 2020, researchers surveyed TVET undergraduate students from southern Thailand's Yala, Pattani, Narathiwat, and Songkhla provinces to understand their needs. The participants indicated they required new solutions to improve their 21st-century skills and academic achievement. This was especially concerning given the poor economic conditions and ongoing civil unrest in the predominantly rural region. Additionally, the COVID-19 pandemic has disrupted educators' ability to teach problem-solving skills and academic achievement for over two years. As a result, a new normal in the education sector has emerged globally, with online and distance learning becoming the norm [31]. Therefore, the researchers wanted to investigate whether the online classroom model could improve problem-solving skills and student-teacher achievement given these challenges.

2.7. Research Objectives

1. To conduct a qualitative literature review to identify which components of an online flipped classroom learning management model are most effective in increasing academic achievement problem-solving skills through a blended problem-based learning approach in online flipped classrooms.

2. Invite a panel of nine experts to evaluate the appropriateness of an online flipped classroom learning management model used for student-teacher problem-solving skills and academic achievement development.

3. To evaluate and assess the effectiveness of the developed learning management model through input from a student-teacher control group and an experimental group.

3. Methods

3.1. Mixed Methods Research

A mixed-methods approach is a research design that combines quantitative and qualitative methods of data collection and analysis to provide a more comprehensive understanding of a research question or phenomenon. In the case of the flipped classroom research study by García-Ruiz et al. [64], the researchers used a mixed-methods approach to evaluate which factors were best suited for a learning model that could be used for increasing PSS and AA of Thai student-teachers.

The systematic review of the literature was one component of the mixed-methods approach. A systematic review is a research study that uses a structured and rigorous process to identify and analyze all relevant literature on a specific topic. In this case, the systematic review was conducted to determine whether there was existing support for the use of an

Commented [SM11]: Research gap analysis is not yet visible. So it is important to write research gaps to strengthen the novelty of the research that has been carried out by describing research that has been carried out by other people, then complement or update your research position so that the novelty will be clear

Commented [SM12]: It is necessary to add research questions as objectives to be achieved from the research that has been carried out

Commented [SM13]: It is necessary to clarify the mix method used, whether exploratory, explanatory or combined. This is important to strengthen the methodology so that the research direction can be seen as a whole.

Commented [SM14]: It is also necessary to explain in diagram form the quantitative and qualitative methodological steps. State the purpose for each. Quantitative methodology uses what? What's the aim? What do you use for qualitative methodology? What's the aim?

Commented [SM15]:
If we compare the methodologies in the abstract section, the methodology tends to be research & development, but the methodology section uses Mix-method. This requires a detailed explanation. Because the Steps in the methodology lead to R&D. So it is necessary to clarify the purpose of each method in the proposed mix method and align it in the abstract section.

online flipped classroom (OFC) pedagogy combined with problem-based learning (PBL) in a blended learning (BL) environment. This study component was a quantitative method of data collection and analysis.

The other component of the mixed-methods approach was evaluating the learning model, a qualitative data collection and analysis method. The researchers used a case study approach to evaluate the learning model, which involved collecting data from multiple sources (e.g., interviews, surveys, and observations). The collected data from these sources were then analyzed using qualitative methods to identify patterns and themes that emerged from the data.

Using a mixed-methods approach, the researchers gathered both quantitative and qualitative data to provide a more complete understanding of the research question. The systematic literature review provided quantitative data on the existing support for the FC pedagogy combined with PBL in a blended learning environment. In contrast, the evaluation of the learning model itself provided qualitative data on the experiences and perceptions of Thai student-teachers using this approach. Combining these two methods allowed the researchers to understand the factors best suited for the learning model and its potential impact on PSS and AA of Thai student-teachers.

Commented [SM16]: Need to explain what type you use? What is explanatory? Is it exploratory? What is combine? And it needs to be clarified which method to use for qualitative and what method to use for quantitative?

3.2. Phase 1 – FPM conceptual development

Commented [SM17]: These phases from phases 1-3 are the steps of development research. So, we have to clarify what this has to do with the mix method being run

Phase 1 entailed retrieving and analyzing available literature on flipped learning, PBL, and BL to develop a model to promote PSS and AA of the student-teachers. Resources used for the analysis were documents, textbooks, articles, and research articles obtained from both Thai and international sources. The retrieval criteria were documents published from -2015 2020 from databases such as the ACM Digital Library, ScienceDirect, SpringerLink, Web of Science, and Elsevier. From the initial search, 70 items were identified and downloaded. Finally, a form was used to conduct a content analysis which was then analyzed and synthesized.

3.3. Phase 2 – FPM development and evaluation

Using the conceptual framework, principles, and methods derived from the qualitative data and the content analysis table, the critical information was synthesized from Phase 1 to assemble a draft model related to the design and development of a flipped PARSER (problem-attempt-research-solutions-evaluation-reflect) Model (FPM). The flipped PARSER learning management model was then tested on Thai student-teachers to determine its effectiveness in developing undergraduate problem-solving skills and learning achievement.

3.3.1. FPM Suitability Evaluation

The assembled panel of experts was selected using purposive sampling and met via Zoom in 2021. The panel had expertise in technology, educational technology, communications education, measurement and evaluation, education course development, and computer engineering. All panel members were Ph.D.s and had at least five years of relevant lecturing experience in a Thai higher education institution.

Commented [SM18]: It is necessary to explain how long the evaluation process took and the evaluation instruments used need to be explained

3.3.2. FPM Suitability Evaluation Instruments

The research instrument was the FPM's suitability assessment form, which used a five-level scale to assess each expert's opinion on three aspects. These aspects were the model's suitability, the component's suitability, and the procedure's suitability. A typical assessment tool used for suitability assessment is the index of item-objective congruency (IOC). From

the IOC use, values for the model were determined to be 0.80-1.00, which is above the recommended minimum of 0.50.

3.3.3. FPM Suitability Evaluation Measurement Criteria

Furthermore, the model's evaluation of the experts' and students' opinions used the mean average and standard deviation (SD) to assess their level of agreement [65]. The 'highest' agreement was indicated by a '5', which used 4.50 - 5.00. This was followed by a 'high' agreement with a '4' and 3.50 - 4.49 mean values. 'Moderate' agreement used a scale value of '3' and mean values of 2.50 - 3.49. 'Little' agreement used a '2' and mean values of 1.50 - 2.49. Finally, the 'no' agreement was indicated with a '1', with mean values of 1.00 - 1.49.

3.4. Phase 3 – FPM Student-Teacher Evaluation

3.4.1. Student-teacher evaluation of the FPM's use

The population for the study's model evaluation was the first-year undergraduate students in a Bachelor of Education program in a Thai private university's Faculty of Education and Liberal Arts in the 2021 academic year. Students were selected using random clusters and systematic random sampling from four disciplines for the final 61 student-teacher samples, including students majoring in the Thai language, science, society, and primary education. In the final sampling phase, a lottery method was used to select the 30-member experimental group (odd numbers) and the 31-member control group (even numbers).

3.4.2 Research tools used for student-teacher FPM use evaluation

The authors utilized various research tools to evaluate the use of the FPM in a learning innovation course using digital media (LICDM) with Thai student-teachers. First, they developed a LICDM Learning Management Plan, consisting of 20 hours of content, which incorporated the FPM. The plan was expertly assessed and received the highest ranking.

The authors used the ADDIE Model to develop the course, a systematic process for developing effective and efficient instruction [66]. The ADDIE Model helps in carefully planning and designing the course, ensuring that it is tailored to the needs of the students. Moodle was the learning management system (LMS) to deliver the course content. Moodle is an effective tool for both in-class and online learning, allowing teachers to create and share teaching materials, integrate cloud-based video hosting platforms, and facilitate communication through chat rooms [56-57].

The quality of the process was evaluated by a panel of educational experts and deemed to be of the highest level. Using these research tools and instructional design techniques, the authors could effectively implement the FPM in their *learning innovation course using digital media* (LICDM) and evaluate its impact on student-teacher performance (Fig. 3).

Commented [SM19]: It is necessary to explain the indicators of the instruments used

Commented [SM20]: It is necessary to explain the indicators of the evaluation instruments carried out by experts

Commented [SM21]: It uses a development research methodology. What is the relationship with the method that has been decided, namely the mix method?

Fig. 3. Online flipped classroom technologies and environments.

3.4.3 PSS and AA Student-Teacher Assessment

Various cloud-based and software tools were used to assess each student-teacher PSS. These included OBS Studio, KineMaster, and their use and understanding of the Moodle LMS [56]. The learning innovation course using digital media used a multiple-choice questionnaire with five options covering three levels of cognition. These included remembering, understanding, and applying [35]. Their index of conformity (IOC) was 0.67–1.00, difficulty was 0.20–0.80, and discrimination power was 0.76.

Furthermore, the learning innovation course using digital media consisted of material focused on four areas, including analysis, researching, decision-making, and planning and practice [59-62], which was characterized as a 4-level Rubrics scoring system having IOC consistency values between 0.83-1.00, a difficulty value between 0.23-0.77, and an Inter-Rater Reliability value for determining the consistency between each other with a Kappa coefficient equal to 0.73.

3.4.4 Student-Teacher Satisfaction Assessment

The study used a student-teacher satisfaction assessment form for the FPM. According to the model, a 5-level Likert evaluation scale measured their opinions on teachers, teaching media and technology, teaching strategy, teaching activities, measurement and evaluation, and the learning process. The IOC consistency values for the form were between 08.0-1.00.

3.4.5 Collection and Analysis of Data

The experiment was conducted using Thai student-teachers in a control group of 31 individuals and an experimental group of 30 individuals who participated in a five-week learning innovation course using digital media (LICDM) in the 2021 academic year (Fig. 4). The experimental group used the FPM to learn, while the control group used a traditional lesson plan. Before the course started and after its end, each group was given a PSS and AA assessment examination. The data input was analyzed using a one-way MANOVA analysis and descriptive statistics (mean and standard deviation) for the student satisfaction assessment of their FPM use.

Commented [SM22]: In figure 3, the writing on the image is too small and the color combination with the writing is a bit biased so it is less legible

Commented [SM23]: It needs to be clarified for AA instruments. Because in the article only a questionnaire with multiple choices is written. It is necessary to explain the indicators used in forming the AA instrument so that it is clear what is being aimed at.

Commented [SM24]: It is necessary to explain the indicators of the instruments used

Commented [SM25]: The type of experimental design carried out is not yet visible and clear

Commented [SM26]: Collecting data and data analysis only focuses on experimental data from the model being developed. Meanwhile, data collection and analysis for the model development process are not explained in detail

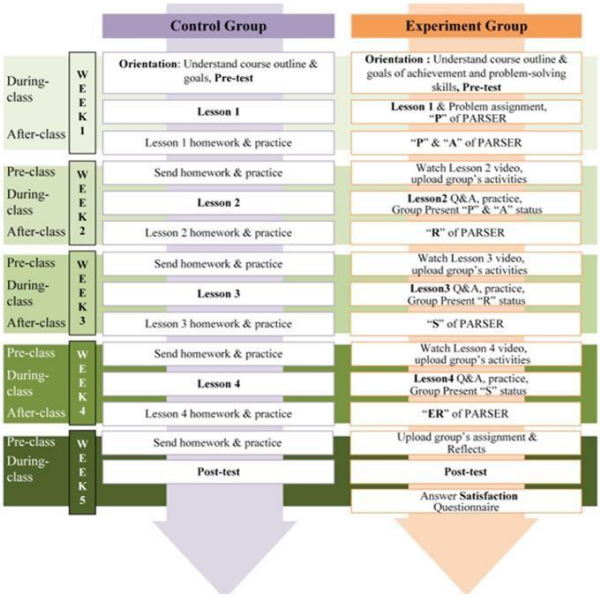


Fig. 4. Experimental activities.

4. Results

The study's results identified three core components of the FAM class: teacher activities, student activities, and an evaluation phase. These components were determined through an online Zoom focus-group discussion with the assistance of nine educational experts. Fig. 5 visually represents the FAM class phases and associated AA and PSS activities.

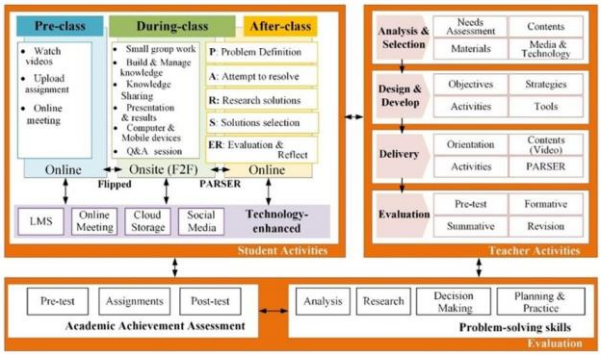


Fig. 5. The FPM for student-teacher problem-solving skills and academic achievement.

4.1. Teacher Activities

Fig. 6 details the FAM teacher activities and their four steps. These include a needs assessment and selection, design and development, delivery, and evaluation.

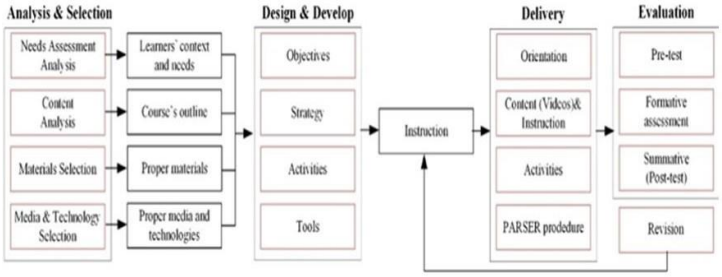


Fig. 6. The FPM teacher activities.

4.1.1. Needs Assessment Analysis

First, a needs assessment analysis is conducted for the learners' context and needs. Later, the content analysis and selection are made to define each course outline. After that, materials, media, and technology are selected for proper and efficient learning materials and technologies.

4.1.2. Design and Development

Second, the instruction is designed and developed with all instruction components defined. This included the learning objectives, teaching strategy, learning activities, and learning and evaluating tools.

4.1.3. FPM Instruction Delivery

Third, an orientation session for the experimental group of student-teachers was used to clear all the learning objectives of the FPM and the potential learning experiences that the student-teachers might encounter both online and on-site. After that, FPM videos and content lectures were delivered to students using digital tools such as Moodle Cloud LMS, cloud storage, and social media platforms. The next FPM step was given to the group at each weekly session's completion. This allowed the student-teachers to participate in after-class activities such as online discussions, brainstorming, researching, and collaboration.

4.1.4. PSS and AA Evaluation

Finally, PSS and AA evaluations are conducted during the course. There is a pre-test, formative assessment, and summative assessment. After that, teachers can evaluate their instruction for revision.

Commented [SM27]: Complete the average result data: pre-test, formative assessment, and summative assessment.

4.2. Student-Teacher Activities

The students had three group activities (pre-class, during, and after class) (Fig. 7).

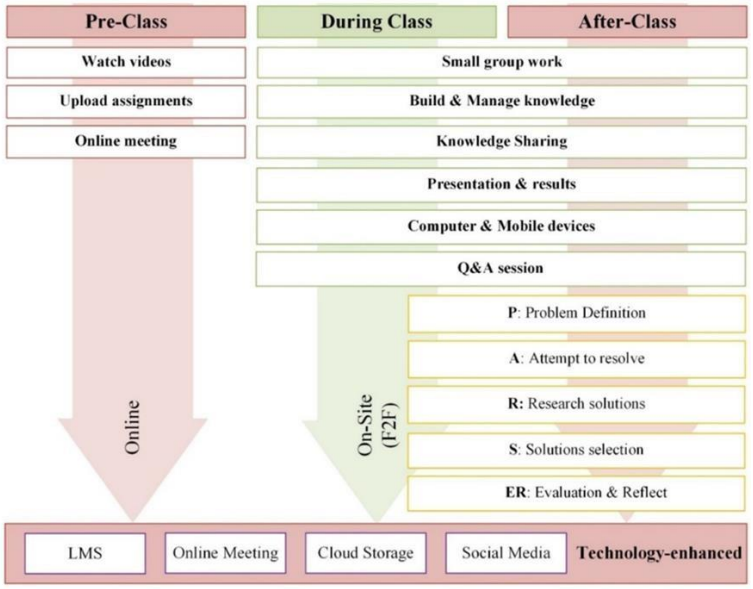


Fig. 7. The FPM student activities.

4.2.1. Pre-class Orientation and FPM Problem Scenario Assignment

The course outline and objectives were introduced to the experimental group in a student-teacher orientation session, followed by the introduction and review of online tools and learning management systems (LMS) for each small group of 5-6 individuals. The students were then assigned an FPM problem scenario with procedures defined.

The pre-class activities involved watching content videos, uploading assignments, and online meetings with peers or the teacher for questioning and brainstorming. The in-class activities consisted of small work groups collaborating to gather and manage knowledge and sharing their progress through presentations on their problem-solving skills (PSS). The teacher addressed questions from the pre-class activities during Q&A sessions.

At the end of each session, new FAM steps were assigned for the following week's class, and absent group members could review the session through Moodle LMS or social media for continued learning and interaction with peers.

The PARSER procedures included five steps to guide the experimental group's problem-solving process: problem definition, attempt to resolve, research solutions, solutions selection, and evaluation and reflection. In the problem definition step (**P**), the group worked to define the assigned problem scenario and utilized online digital tools to aid their teamwork. The attempt to resolve step (**A**) involved each member using their previous knowledge and experiences to solve the problem and exchanging knowledge with the group through discussion, analysis, and brainstorming. In the research solutions step (**R**), each member researched and explored possible solutions online, which were then shared and defended within the group. The solutions selection step (**S**) required the group to discuss and select the best solution for a group presentation to the class, where the group representative presented the selected solution and supporting evidence. The final step, evaluation and reflection (**ER**) involved the students evaluating their **PARSER** experience, reflecting on their solutions, and discussing their PSS learning process with the teacher.

Commented [SM28]: It is necessary to explain how long the learning process takes and what material is taught

4.2.2. FPM Appropriateness Evaluation

The FPM appropriateness questionnaire consisted of a 5-level Likert scale used to evaluate and certify the FPM by nine qualified educational experts. The assessment was undertaken using both the mean ($\bar{x}$) and SD (Table 4), from which it was determined that the overall FPM was evaluated at a *high* level ($\bar{x}$=4.13, SD=0.19) by the experts.

Table 4.
Overall and individual aspects classify the FPM's mean, SD, and suitability.

Aspects	Experts (n=9)		Suitability Level
	$\bar{x}$	SD	
Format/method of learning management	4.08	0.10	High
Learning management model components	4.13	0.21	High
Learning management model process	4.17	0.09	High
Summation	4.13	0.19	High

4.2.3. FPM TryOut

Table 5 shows that the experimental group's use of the FPM had higher mean scores of AA and PSS than the control group. It was also statistically significant at the .01 level.

Table 5.
Mean and SD of student-teacher achievement and PSS classified by group.

Dependent variables	Full score	Control group (n=31)		The experimental group (n=30)	
		$\bar{x}$	SD	$\bar{x}$	SD
Academic achievement (AA)	100	47.83	11.85	60.14	10.32
Problem-solving skills (PSS)	100	60.42	1.55	68.77	2.05

However, the determination of a statistically significant increase needed to be clarified. Therefore, further testing was done using the one-way MANOVA statistic. Therefore, before the testing, the researchers conducted further testing using Table 6.

Table 6.
Statistic for preliminary examination of the agreement.

Test	Statistics	Test results
Normal distribution	Kolmogorov-Smirnov Test (Sig. ≥ .05)	Achievement, Sig.=.45 Skill; Sig.=.09
Testing Homogeneity of Covariance Matrices	Box's M Test (Sig. ≥ .05)	Box's M = 3.28, F=1.05, Sig.=.37
Relationship between the dependent variables	Pearson correlation (0.20 ≤ r ≥ 0.80)	r= 0.58, Sig.<.00

Table 7 details the ANOVA multiple testing to compare AA and PSS of the experimental and control group student-teachers

Commented [SM29]:
In table 6: Adjust the table to the journal template

Table 7.
MANOVA testing results for student-teacher AA and PSS for both the experimental and control groups.

Effect		Value	F	Hypothesis df	Error df	Sig.
Intercept	**Pillai's Trace**	.999	40641.601[b]	2	58	.000
	Wilks' Lambda	.001	40641.601[b]	2	58	.000
	Hotelling's Trace	1401.435	40641.601[b]	2	58	.000
	Roy's Largest Root	1401.435	40641.601[b]	2	58	.000
Group	**Pillai's Trace**	.848	162.251[b]	2	58	.000
	Wilks' Lambda	.152	162.251[b]	2	58	.000
	Hotelling's Trace	5.595	162.251[b]	2	58	.000
	Roy's Largest Root	5.595	162.251[b]	2	58	.000

Tests of Between-Subjects Effects

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F
Corrected Model	Academic achievement (AA)	2312.274[a]	1	2312.274	18.671
	Problem-solving skills (PSS)	1062.273[b]	1	1062.273	322.722
Intercept	Academic achievement (AA)	177720.924	1	177720.924	1435.068
	Problem-solving skills (PSS)	254442.289	1	254442.289	77300.460
Group	Academic achievement (AA)	2312.274	1	2312.274	18.671
	Problem-solving skills (PSS)	1062.273	1	1062.273	322.722
Error	Academic achievement (AA)	7306.647	59	123.841	
	Problem-solving skills (PSS)	194.204	59	3.292	
Total	Academic achievement (AA)	186723.419	61		
	Problem-solving skills (PSS)	255228.276	61		
Corrected Total	Academic achievement (AA)	9618.921	60		
	Problem-solving skills (PSS)	1256.478	60		

**Sig. ≤.01, a. R^2 = .240 (Adjusted R^2 =.228. b. R^2=.845) (Adjusted R^2=.843)

4.2.4. FPM Student-Teacher Satisfaction

Table 8 shows that there was overall a high level of student-teacher satisfaction with their use of the FPM ($\bar{x}$=4.41, SD=0.66). Of the five FPM steps, Step 5 (evaluation and reflection) was considered the most satisfying ($\bar{x}$=4.60, SD=0.60). This was followed by Step 3's research solutions ($\bar{x}$=4.45, SD=0.620).

Table 8.
Mean, SD and overall student-teacher FPM satisfaction are classified by overall and individual aspects.

FPM	Students (n=30)		Satisfaction Level
	$\bar{x}$	SD	
Step 1-Problem definition (P)	4.36	0.76	High
Step 2-Attempt to resolve (A)	4.39	0.64	High

Step 3-Research solutions (R)	4.45	0.62	High
Step 4-Solutions selection (S)	4.36	0.66	High
Step 5-Evaluation and reflection (ER)	4.50	0.60	Highest
Summation	4.41	0.66	High

Commented [SM30]: In table 6: Adjust the table to the journal template

5. Discussion

Higher education faces various challenges beyond the impact of the COVID-19 pandemic. These challenges include issues such as rural poverty, civil unrest, student protest [67], student mental health [68], unstable ICT infrastructure [4-5], high ICT costs, inadequate training for educators and students, and continued reliance on traditional, teacher-centered instructional approaches [69-70].

Commented [SM31]: The discussion section should contain phenomena from the research results for further discussion by comparing the results of the meeting with previous research. So, the discussion section no longer discusses the problems faced but focuses on the findings from research that has been carried out and compared with the results of previous studies to see whether they strengthen or falsify them.

However, what can be directly contributed to the pandemic is the accelerated requirement for online education and distance learning [31]. However, this has thrown the teachers and students into the fire, ill-prepared to meet the challenges. Too many school systems expect the students and educators to shelf-teach' themselves into what is needed to participate in online learning.

From the pandemonium, countless educators reached out for new methods to implement the new requirements. Fortunately, numerous studies have already been conducted on newer, non-traditional pedagogies and models for use in online learning [71]. These have included flipped classrooms using various learning methods, including blended, inquiry-based, problem-based, student-centered, and online/distance learning [2],[4] [7],[10], [14], [64], [72].

This study highlights the importance of utilizing a combination of teaching and learning methods to address the shortcomings in problem-solving skills and academic achievement scores. The authors recognize that there is no one-size-fits-all solution and that a tailored approach is necessary. In the case of this study, the authors aimed to address these issues in Thailand, which have been on the decline even before the pandemic. Overcoming these issues is even more challenging in rural areas, where access to ICT infrastructure is limited, and civil strife has been ongoing. Thus, it is crucial to implement effective strategies that are designed for the unique needs of different regions and communities.

For proof of these statements, one does not have to look too hard in Thailand as Thailand's Programme for International Student Assessment (PISA) scores have been anything but spectacular and dropping test after test [60], [73-73]. This has led to a potentially dangerous situation for Thailand's economic vitality compared to its highly competitive and aggressive ASEAN neighbors.

However, these problems are not unique to Thailand as other academics have pointed out that other Asian instructors and students have been negatively anxious concerning the use of full-online courses, which has necessitated significant support from students' families and their faculties [75], especially in female students [76].

5.1. Online Flipped Classrooms (FC)

It is critical to note that the effectiveness of the online flipped classroom was confirmed not only in raising academic achievement scores and problem-solving skills but also in increasing student satisfaction with the FPM. The positive feedback from student-teachers is essential, as it suggests that the OFC can improve academic outcomes and student engagement.

These findings are consistent with Romero-García et al. [77], who found that the authors' flipped learning model resulted in higher student satisfaction and academic performance.

This underscores the value of innovative teaching methods in promoting positive student outcomes.

5.2. Problem-Based Learning (PBL)

PBL methods were again confirmed as instrumental pedagogy in teaching PSS. When combined with online learning and flipped classrooms, the study's results were higher than those using traditional classroom methods. This is consistent with other studies which showed that FCs and PBL activated creative thinking and digital media skills [78], creative innovation skills [25], creative thinking skills [79], and problem-solving skills [80-81].

5.3. Problem Solving-Skills (PSS)

Multiple studies have determined that disadvantaged students in rural areas must be sufficiently prepared to balance their real life with study life in an online learning environment [82-84]. However, the COVID-19 pandemic has forced the issue, and online study has become required. Therefore, with multiple Thai PSS studies showing severe weakness in most students [26], the authors set out to develop a model to strengthen PSS capabilities and scores.

Fortunately, in an experimental group of 30 student-teachers, success on a limited scale was achieved as their PSS scores were higher ($\bar{x}$=68.77, SD=2.05) than the control group ($\bar{x}$=60.42, SD=2.05) in post-class testing on a 100-point scale. These results were consistent with a study of university students in Saudi Arabia in which the authors remarked that the use of blended learning in an online flipped classroom had the most significant impact on acceptance within the country [85].

5.4. Academic Achievement (AA)

In this study, Thai student-teacher AA was shown to improve significantly when compared to the control group. This was due to the 30-member experimental group's success in achieving a AA post-course score of $\bar{x}$=60.14, SD=10.32. This was significantly higher than the control group's post-course score of $\bar{x}$=47.83, SD=11.85 on a 100-point scale.

5.5. Blended Learning (BL)

The literature review and this study's FAM application showed that BL is highly effective when used with an FC. This is consistent with other studies, such as Kang and Kim [86], who found the effectiveness of FC and BL in a public healthcare course. Cox [87] examined the differences between high-school teacher training in ten Arizona schools and the actual uses of a BL/FC environment after the training and found that hands-on use was required to be effective. Purba [88] also used a BL/FC environment and the Edmodo LMS in the author's 32-student study and determined that the LMS was an effective tool for online, home-based student learning.

6. Conclusion

The authors aimed to validate the effectiveness and usefulness of an online flipped classroom model in enhancing student-teacher academic achievement (AA) scores and problem-solving skills (PSS). Valuable expert input was incorporated into the Flipped PARSER Model's design, which included online and on-site activities before, during, and after classes. The instructors' role encompassed content selection, media and material design and development, learning activities and tools, lesson delivery, and evaluation. The study found that the Flipped PARSER Model was highly satisfactory for student-teachers, with positive AA scores and PSS outcomes.

7. Limitations and Suggestions

Commented [SM32]: This is the discussion section. It should not only display quantitative data from experimental results. However, the experimental data explains why it is significant, what factors cause it and compares it with the results of previous studies.

Commented [SM33]: The finding that "study's FAM application showed that BL is highly effective when used with an FC" should be explored with a qualitative study in accordance with the method chosen, namely mix method

Commented [SM34]: Need to add implications from the research that has been carried out

First, the study was limited because the sample was from a single Thai private university in Thailand's deep south. This area is highly rural and faces significant challenges due to decades of civil strife. These conditions have combined to make ICT infrastructure challenging to obtain and costly. Other studies in a more urban and peaceful environment might find higher AA and PSS scores when FC and blended learning are used.

Second, the study should have considered the long-term effects of using the Flipped PARSER Model on student-teacher academic performance and problem-solving skills. Future research could focus on tracking students' progress over a more extended period to determine the sustainability of the observed improvements.

Third, the study did not consider the effects of other variables, such as the socio-economic background of students and the academic qualifications of teachers, on the outcomes of the Flipped PARSER Model. Future research could examine these variables' impact on the model's effectiveness.

Finally, the study should have provided a comparison group that received traditional teaching methods. Future research could include a comparison group to determine the effectiveness of the Flipped PARSER Model in comparison to traditional teaching methods.

Commented [SM35]: It is necessary to add to the shortcomings of this research, namely that the research method is not clear with the type of mix-method, namely exploratory, exploratory or merge/simultaneous.

Author Contributions: Conceptualization, CN, and AS; Software, PP, and AS; Validation, CN, PP, and TK; Formal analysis, CN, PP, and AS; Investigation, CN, and AS; Resources, CN, and PP; Writing—original draft preparation, CN, and AS; Writing—review and editing, CN, PP, and AS; Supervision, PP, and AS All authors have read and agreed to the published version of the manuscript.

Funding: This article processing charge was funded by the School of Industrial Education and Technology, King Mongkut's Institute of Technology Ladkrabang (KMITL), Bangkok, Thailand.

Institutional Ethics Review Board Statement: Before the study's commencement, a study author attended a National Research Council of Thailand (NRCT) sponsored Forum for Ethical Review Committees in Thailand (FERCIT) and obtained a '*Research Ethics Training Course*' certificate of completion on 27 May 2022. After that, the authors sought study approval from their Human Ethics Committee. After approval was granted, the study's panel of educational experts and student-teacher participants were sent an explanation for the study's research via email or Line messaging. In the message, confidentially was assured. After receiving the agreement, the documents were securely stored in a faculty facility.

Informed Consent Statement: Not applicable.

Acknowledgments: The authors thank Ajarn Charlie for his assistance in English language editing support.

Conflicts of Interest: The authors declare no conflict of interest.

References

1. Johari, M. K.; Jamil, N. Z. Practicality of ad hoc online assessments for teaching ESP in online flipped classrooms during COVID-19. *Proceedings* **2022** 82(1), 91. https://doi.org/10.3390/proceedings2022082091
2. Ruenphongphun, P.; Sukkamart, A.; Pimdee, P. Developing Thai undergraduate online digital citizenship skills (DCS) under the New Normal. *J. High. Educ. Theor. Pract.* **2022** *22*(9), 16–30. https://doi.org/10.33423/jhetp.v22i9.5358
3. The "Skip online learning" campaign launched Monday. Thai PBS. (2021, September 6). Available online: https://tinyurl.com/n8nzrnsn (accessed on 7 May 2023)

Commented [SM36]: In accordance with the rules for writing references, it would be better to use references in the form of journals

4. Phuapan, P.; Viriyavejakul, C.; & Pimdee, P. An Analysis of digital literacy skills among Thai university seniors. *Int. J. Emerg. Technol. Learn.* 2015 11(3) 24 – 31. https://doi.org/10.3991/ijet.v11i03.5301
5. Watnayoo, C.; Toonthong, S.; Chalaywares, N. Developing the 21st-century skills on information, media, and technology on computer creativity towards learning for Grade 5 students using coaching. *Thai J. Sci. Technol*. 2019 10(1), 1 – 16. Available online: https://tinyurl.com/29z8dw4n (accessed on 7 May 2023)
6. Chudak, T. Implementation of a flipped classroom SLA model in the conditions of a language school. *e-mentor* **2022** *3*(95), 22-31. https://doi.org/10.15219/em95.1570
7. Shih, W.-L.; Tsai, C.-Y. Students' perception of a flipped-classroom approach to facilitating online project-based learning in marketing research courses. Aust. J. Educ. Technol. **2017** *33*(5). https://doi.org/10.14742/ajet.2884
8. Bergman, J.; Sams, A. *Flip your classroom: Reaching every student in every class every day*, 1st ed.; International Society for Technology in Education, 2012.
9. Chinchua, S.; Kantathanawat, T.; Tuntiwongwanich, S. Increasing programming self-efficacy (PSE) through a problem-based gamification Digital Learning Ecosystem (DLE) Model. *J. High. Educ. Theor. Pract.* **2022** *22*(9), 131-143. https://doi.org/10.33423/jhetp.v22i9.5370
10. Charungkaittikul, S.; Henschke, J. A. (2014). Strategies for developing a sustainable learning society: An analysis of lifelong learning in Thailand. *Int. Rev. Educ.* **2014** 60(4), 499-522. https://doi.org/10.1007/s11159-014-9444-y
11. Ceker, E.; Ozdamli, F. Features and characteristics of problem-based learning. *Cypriot J. Educ. Sci.* **2016** *11*(4), 195–202. https://doi.org/10.18844/cjes.v11i4.1296
12. Kanelopoulos, J.; Papanikolaou, K. A.; Zalimidis, P. Flipping the classroom to increase students' engagement and interaction in a mechanical engineering course on machine design. Int. J. Eng. Pedagog. **2017** *7*(4), 19–34. https://doi.org/10.3991/ijep.v7i4.7427
13. Uskokovic, V. Flipping the flipped: the co-creational classroom. *Res. Pract. Technol. Enhanc. Learn.* **2018** *13*(1), 1-24. https://doi.org/10.1186/s41039-018-0077-9
14. Özyurt, H.; Özyurt, Ö. (2018). Analyzing the effects of adapted flipped classroom approach on computer programming success, attitude toward programming, and programming self- efficacy. *Comput. Appl. Eng. Educ*. **2018** *26*(6), 2036-2046. https://doi.org/10.1002/cae.21973
15. Pattanaphanchai, J. An investigation of students' learning achievement and perception using flipped classroom in an introductory programming course: A case study of Thailand higher education. *J. Univ. Teach. Learn. Pract.* **2019** 16(5), 4. https://doi.org/10.53761/1.16.5.4
16. Roach, T. Student perceptions toward flipped learning: New methods to increase interaction and active learning in economics. Int. Rev. Econ. Educ. **2014** *17*(1), 74–84. https://doi.org/10.1016/j.iree.2014.08.003
17. Aqqal, A.; Elhannani, A.; Haidine, A.; Dahbi, A. Improving the teaching of ICT engineering using flipped learning: A personalized model and a case study. *Production*, **2017** 27(spe). https://doi.org/10.1590/0103-6513.227416
18. Flores, O.; del-Arco, I.; Silva, P. The flipped classroom model at the university: an analysis based on professors' and students' assessment in the educational field. *Int. J. Educ. Technol. High. Educ.* **2016** *13*(1), 1-12. https://doi.org/10.1186/s41239-016-0022-1
19. Wang, K.; Zhu, C. MOOC-based flipped learning in higher education: students' participation, experience, and learning performance. *Int. J. Educ. Technol. High. Educ*. **2019** *6*(1), 1-18. https://doi.org/10.1186/s41239-019-0163-0
20. Leary, H.; Walker, A.; Lefler, M.; Kuo, Y-C. Self- Directed Learning in Problem-Based Learning: A Literature Review." In Moallem, M.; Hung, W.; Dabbagh, N. Eds.; *The Wiley Handbook of Problem- Based Learning* **2019,** 181-198. https://doi.org/10.1002/9781119173243.ch8

21. Banic, A.; Gamboa, R. Visual design problem-based learning in a virtual environment improves computational thinking and programming knowledge. In 2019 IEEE Conference on Virtual Reality and 3D User Interfaces (VR) (1588 – 1593). IEEE. https://doi.org/10.1109/VR.2019.8798013
22. Wood, D. F. Problem-based learning. *BMJ Clinical Research* 2003 *326*(328). https://doi.org/10.1136/bmj.326.7384.328
23. Rajaram, K. Engaging learners: A flipped classroom approach. In Evidence-Based Teaching for the 21st Century Classroom and Beyond. Springer, 2021. https://doi.org/10.1007/978-981-33-6804-0_2
24. Teo, T. W.; Tan, K.C.D.; Yan, Y. K.; Teo, Y. C.; Yeo, L. W. How flip teaching supports undergraduate chemistry laboratory learning. *Chem. Educ. Res. Pract.* **2014** *15*(4), 550-567. https://doi.org/10.1039/C4RP00003J
25. Wannapiroon, N.; Petsangsri, S. Effects of STEMification Model in flipped classroom learning environment on creative thinking and creative innovation. *TEM Journal* **2020** 9(4), 1647-1655. https://doi.org/10.18421/TEM94-42
26. Sermsri, N.; Sukkamart, A.; Kantathanawat, T. Thai computer studies student teacher complex problem-solving skills development: A cooperative learning management model. *J. High. Educ. Theor. Pract. 2022 22*(16), 87-99. https://doi.org/10.33423/jhetp.v22i16.5603
27. Rodrangsee, B.; Tuntiwongwanich, S.; Pimdee, P.; Moto, S. Development of an online active learning model using the Theory of Multiple Intelligence to encourage Thai undergraduate student analytical thinking skills. *J. High. Educ. Theor. Pract.* **2022** *22*(12), 63-75. https://doi.org/10.33423/jhetp.v22i12.5463
28. Moto, S.; Ratanaolarn, T.; Tuntiwongwanich, S.; Pimdee, P. A Thai junior high school students 21st-century information literacy, media literacy, and ICT literacy skills factor analysis. *Int. J. Emerg. Technol. Learn.* **2018** *13*(9), 87-106. https://doi.org/10.3991/ijet.v13i09.8355
29. Siripongdee, K.; Tuntiwongwanich, S.; Pimdee, P. (2021). Blended learning model with IoT-based by smartphone. *Int. J. Interact. Mob. Technol.* **2021** *15*(11), 166 - 182. https://doi.org/10.3991/ijim.v15i11.22441
30. Mallapaty, S. China's zero-COVID strategy: what happens next? *Nature* **2022** *602*(7895), 15-16. https://doi.org/10.1038/d41586-022-00191-7
31. UNESCO. Education Minister Nataphol Teepsuwan on COVID-19 strategy in Thailand. 21 April 2020. Available online: https://tinyurl.com/4kev72z5 (accessed on 7 May 2023)
32. Luo, Z.; O'Steen, B.; Brown, C. Flipped learning wheel (FLW): A framework and process design for flipped L2 writing classes. *Smart Learn. Environ*. **2020** *7*(10), 1-21. https://doi.org/10.1186/s40561-020-00121-y
33. Tomas, L.; Evans, S.N.; Doyle, T.; Skamp, K. Are first-year students ready for a flipped classroom? A case for a flipped learning continuum. *Int. J. Educ. Technol. High. Educ.* **2019** *16*(5), 1-22. https://doi.org/10.1186/s41239-019-0135-4
34. Talbert, R. *Flipped learning: A guide for higher education faculty.* Stylus Publishing, LLC.m 2017.
35. Anderson, L. W.; Krathwohl, D. R. A taxonomy for learning, teaching, and assessing: A revision of Bloom's taxonomy of educational objectives. Longman, 2001. Available online: https://tinyurl.com/yhcrps7x (accessed on 7 May 2023)
36. Wijnia, L.; Loyens, S.M.M.; Rikers, R.M.J.P. The problem- based learning process: An overview of different models. In *The Wiley Handbook of problem- based learning*, 2019; pp. 273-295. https://doi.org/10.1002/9781119173243.ch12
37. Guilford, J. P. *The Analysis of Intelligence.* McGraw-Hill Book, New York, 1971.
38. Weir, J. J. Problem solving is everybody's problem. *The Science Teacher* **1974** *41*(4), 16-18. https://www.jstor.org/stable/24123495
39. Schmidt, H.G. Problem- based learning: Rationale and description. *Medical Education* 1983 17(1), 11-16. https://doi.org/10.1111/j.1365-2923.1983.tb01086.x

Commented [SM37]: In accordance with the rules for writing references

40. Woods, R. D. (1985). Problem-based learning and problem-solving. In *Problem-Based Learning for the Professions*, David B. Ed.; Higher Education Research and Development Society of Australasia. (19-42).
41. Ong, A.C.; Borich, D.G. (2006). *Teaching Strategies that Promote Thinking.* McGraw-Hill Education.
42. Al Said, R. S.; Du, X.; ALKhatib, H.A.H.; Romanowski, M.H.; Barham, A.I.I. Math teachers' beliefs, practices, and belief change in implementing problem-based learning in Qatari primary governmental schools. *EURASIA J. Math. Sci. Tech. Ed.* **2019** *15*(15), em1710. https://doi.org/10.29333/ejmste/105849
43. Maudsley, G. Do we all mean the same thing by 'problem-based learning'? A review of the concepts and a formulation of the ground rules. *Academic Medicine*, **1999** *74*(2), 178-185. https://doi.org/10.1097/00001888-199902000-00016
44. Blayney, N. Problem-based learning: A new approach in medical education. *In Practice*, **2003** *25*(2), 101- 106. https://doi.org/10.1136/inpract.25.2.101
45. Srakaew, S.; Polvichai, J.; Sugiyama, Y.; Motohashi, K.; Mochizuki, A.; Ohara, K.; Shirouzu, M. Development and verification survey of human resource development program in engineering utilizing e-Learning system and project-based learning in engineering with the cooperation of Japan and Thailand for the New Normal after COVID-19. *Int. J. Adv. Res. Eng. Innov.* **2021** *3*(3) **2021,** 76-83. Available online: https://tinyurl.com/btyrjjw9 (accessed on 7 May 2023)
46. Talbert, R. Inverting the linear algebra classroom. *Primus*, **2014** *24*(5), 361-374. https://doi.org/10.1080/10511970.2014.883457
47. Bangthamai, E. The development of instructional activities model by problem-based learning to enhance problem-solving abilities on digital photography course for undergraduate students Faculty of Education, Silpakorn University. *Veridian E-J. Silpakorn Univ.* **2018** *11*(1). Available online: https://tinyurl.com/mww73m59 (accessed on 7 May 2023)
48. Mathew, R.; Malik, S.I.; Tawafak, R.M. Teaching problem-solving skills using an educational game in a computer programming course. *Inform. Educ.* **2019** *18*(2), 359-373. https://doi.org/10.15388/infedu.2019.17
49. Durak, H. Y.; Yilmaz, F.G.K.; Yilmaz, R. Computational thinking, programming self-efficacy, problem-solving, and experiences in the programming process conducted with robotic activities. *Contemp. Educ. Tech.* **2019** *10*(2), 173 – 197. https://doi.org/10.30935/cet.554493
50. Kraiklang, J.; Chomchid, P.; Thansupho, P. Instructional approaching management through the problem-based learning model for enhancing students' learning achievements and their solving-problem abilities toward science of lower secondary educational students at the 9th-grade level. *Eur. J. Educ. Stud.* **2017** *3*(4), 447-465. https://doi.org/10.5281/zenodo.401064
51. Panjan, S. A STEM robotics workshop to promote computational thinking process of pre-engineering students in Thailand: STEMROBOT. In *25th International Conference on Computers in Education* 2017 pp. 514 –522.
52. Bizami, N. A.; Tasir, Z.; Kew, S. N. Innovative pedagogical principles and technological tools capabilities for immersive blended learning: A systematic literature review. *Edu. Inf. Technol.* **2022** 1-53. https://doi.org/10.1007/s10639-022-11243-w
53. Mozelius, P.; Rydell, C. Problems affecting successful implementation of blended learning in higher education-the teacher perspective. *Int. J. Inf. Commun. Technol. Educ*. **2017** *6*(2), 4–13. https://doi.org/10.1515/ijicte-2017-0001
54. Sothayapetch, P.; Lavonen, J. Technological pedagogical content knowledge of primary school science teachers during the COVID-19 in Thailand and Finland. *EURASIA J. Math. Sci. Tech. Ed.* **2022** 18(7), em2124. https://doi.org/10.29333/ejmste/12118

55. Ceylan, V. K.; Elitok Kesici, A. Effect of blended learning to academic achievement. *J. Hum. Sci.* **2017** 14(1), 308–320. Available online: https://tinyurl.com/mbhkx5ru (accessed on 7 May 2023)
56. Nantha, C.; Pimdee, P.; Sitthiworachart, J. 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. *Int. J. Emerg. Technol. Learn.* **2022** *17*(14), 20–38. https://doi.org/10.3991/ijet.v17i14.30903
57. Polhun, K.; Kramarenko, T.; Maloivan, M.; Tomilina, A. Shift from blended learning to distance one during the lockdown period using Moodle: test control of students' academic achievement and analysis of its results. *J. Phys. Conf. Ser.* **2021** 1840(1), 012053. https://doi.org/10.1088/1742-6596/1840/1/012053
58. Schmidt, H. G.; Moust, J. H. (2000). Factors affecting small-group tutorial learning: A review of research. In Problem-based learning: A research perspective on learning interactions, Evensen, D.H., Hmelo-Silver, C.E., Eds.; Routledge. (19-52). Available online: https://tinyurl.com/28772v7r (accessed on 7 May 2023)
59. Indeed Editorial Team. (2020). Problem-Solving Skills: Definitions and Examples. Available online: https://tinyurl.com/4cn45bw6 (accessed on 7 May 2023)
60. Organization for Economic Cooperation and Development. (2017). *PISA 2015 Results (Volume V): Collaborative Problem Solving*, PISA, OECD Publishing, Paris. http://dx.doi.org/10.1787/9789264285521-en
61. Hapha, N. (2015). Effects of e-learning by using problem-based learning and value clarification for moral decision of undergraduate students, educational technology major, Silpakorn University. *Veridian E-Journal*, 8(2), 1749-1765.
62. Kruthgat, S. (2014). A model development of problem-solving skills by the individual teaching for nurse students of Praboromarajchanok Institute. Chulalongkorn University. https://www.car.chula.ac.th/display7.php?bib=b2050614 (in Thai)
63. Adebola, O.; Ademola, I. A. School quality factors and secondary school students' achievement in mathematics in South-Western and North-Central Nigeria. *The African Symposium.* **2011** *1*, 91-100.
64. García-Ruiz, C.; Lupión-Cobos, T.; Blanco-López, Á. Effects of an inquiry-based science education training program on pre-service teachers. A mixed-methods case study. *EURASIA Journal of Mathematics, Science and Technology Education,* **2022** *18*(12), em2186. https://doi.org/10.29333/ejmste/12578
65. Pimdee, P.; Leekitchwatana, P. Appropriate Internet Use Behavior (AIUB) of Thai preservice teachers: A hierarchical linear model (HLM) analysis. *Int. J. Instr.* **2022** *15*(1)**,** 489-508. https://doi.org/10.29333/iji.2022.15128a
66. Rahmelina, L.; Firdian, F.; Maulana, I.; Aisyah, H.; Na'am, J. (2019). The effectiveness of the flipped classroom model using e-learning media in introduction to information technology course. *Int. J. Emerg. Technol. Learn.* **2019** 14(21), 148-162. https://doi.org/10.3991/ijet.v14i21.10426
67. Kanawapee, C.; Petsangsri, S.; Pimdee, P. The importance of sharing, caring, and collaboration in Thai teacher competency development through online professional learning communities. *J. Posit. Psychol. Wellbeing*, **2022** *6*(1), 3674-3689. Available online: https://tinyurl.com/bdd9spm9 (accessed on 7 May 2023)
68. Yurayat, P.; Tuklang, S. University student counselees' attitudes and experiences towards online counseling during the Covid-19 pandemic: A mixed methods study. *J. High. Educ. Theor. Pract.* **2023** *23*(4)**,** 222-238. https://doi.org/10.5539/hes.v12n1p72
69. Vangmeejongmee, C.; Naiyapatana, O. Competency of Thai Teacher in 21st Century: Wind of change. *J. HR Intell.* **2017** 12(2), 48 – 63. Available online: https://tinyurl.com/284nbcyy (accessed on 7 May 2023)
70. Wongpratoom, W.; Sranamkam, T. The effects of blended learning using collaborative learning with stad technique on MOODLE to enhance analytical

thinking for grade VII students. *Int. J. Learn. Teach.* **2019** *5*(4)**,** 280-284. https://doi.org/10.18178/ijlt.5.4.280-284

71. Parkes, M.; Stein, S.; Reading, C. Student preparedness for university e-learning environments. *Int. High. Educ.* **2015** *25*, 1-10. https://doi.org/10.1016/j.iheduc.2014.10.002
72. Gabriella, A. Inquiry-based learning in Science Education. Why e-learning can make a difference. *J. e-Learn. Knowl. Soc.* **2013** *9*(2), 17-26. https://doi.org/10.20368/1971-8829/831
73. Pholphirul, P.; Teimtad, S. Living with parents and educational outcomes in developing countries: empirical evidence from PISA Thailand. *J. Popul. Res.* **2018** *35*(1), 87-105. https://doi.org/10.1007/s12546-017-9196-1
74. Srijamdee, K.; Pholphirul, P. Does ICT familiarity always help promote educational outcomes? Empirical evidence from PISA-Thailand. *Educ. Inf. Technol.* **2020** *25*(4), 2933-2970. https://doi.org/10.1007/s10639-019-10089-z
75. Pham, T.; Vinh, N. Online learning amid Covid-19 pandemic: students' experience and satisfaction. *J. e-Learn. Knowl. Soc.* **2021** *17*(1), 39-48. https://doi.org/10.20368/1971-8829/1135293
76. Cadamuro, A.; Bisagno, E.; Rubichi, S.; Rossi, L.; Cottafavi, D.; Crapolicchio, E.; Vezzali, L. Distance learning and teaching as a consequence of the Covid-19 pandemic: a survey of teachers and students of an Italian high school taking into account technological issues, attitudes and beliefs toward distance learning, metacognitive skills. *J. e-Learn. Knowl. Soc.* **2021** *17*(1), 81-89. https://doi.org/10.20368/1971-8829/1135463
77. Romero-García, C.; Buzón-García, O.; Touron, J. The flipped learning model in online education for secondary teachers. *J. Technol. Sci. Educ.* **2018** *9*(2), 109-121. https://doi.org/10.3926/jotse.435
78. Srikan, P.; Pimdee, P.; Leekitchwatana, P.; Narabin, A. Problem-based learning (PBL) and teaching model using a cloud-based constructivist learning environment to enhance Thai undergraduate creative thinking and digital media skills. *Int. J. Interact. Mob. Technol.* **2021** *15*(22), 68-83. https://doi.org/10.3991/ijim.v15i22.24963
79. Diawati, C.; Liliasari, S.; Buchari. Students' construction of a simple steam distillation apparatus and development of creative thinking skills: A project-based learning. *AIP Conference Proceedings* 2017 *1848*(1), 1-6. https://doi.org/10.1063/1.4983934
80. Janpla, S.; Piriyasurawong, P. The development of problem-based learning and concept mapping using a block-based programming model to enhance the programming competency of undergraduate students in computer science. *TEM Journal* **2018** 7(4), 708–716. https://doi.org/10.18421/TEM74-02
81. Jewpanich, C.; Piriyasurawong, P. Project-based learning using discussion and lesson-learned methods via social media model for enhancing problem-solving skills. *Int. Educ. Stud.* **2015** *8*(6). https://doi.org/10.5539/ies.v8n6p24
82. Coman, C.; Țîru, L.G., Meseșan-Schmitz, L.; Stanciu, C.; Bularca, M. C. Online teaching and learning in higher education during the coronavirus pandemic: Students' perspective. *Sustainability* **2020** *12*(24), 10367. MDPI AG. http://dx.doi.org/10.3390/su122410367
83. Dhawan, S. Online learning: A panacea in the time of COVID-19 crisis. *Journal of Edu. Technol. Syst.* **2020** *49*(1), 5-22. https://doi.org/10.1177/0047239520934018
84. Que, L. T. M. Online teaching and learning in higher education during Covid-19pPandemic: Vietnamese students' perspective. *IUP J. Inf. Technol.* **2021** *17*(3), 23-48. https://doi.org/10.4324/9781003125921
85. Alyoussef, I.Y. Acceptance of a flipped classroom to improve university students' learning: An empirical study on the TAM model and the unified theory of acceptance

and use of technology (UTAUT). *Heliyon* **2022** *8*(12) e12529. https://doi.org/10.1016/j.heliyon.2022.e12529

86. Kang, H. Y.; Kim, H. R. Impact of blended learning on learning outcomes in the public healthcare education course: a review of flipped classroom with team-based learning. *BMC Medical Education* **2021** *21*(1), 1-8. https://doi.org/10.1186/s12909-021-02508-y
87. Cox, K.M. Teachers' descriptions of effective professional development provided to implement a blended learning flipped classroom. Doctoral dissertation, Grand Canyon University, 2020. Available online: https://tinyurl.com/yzudjbn4 (accessed on 7 May 2023)
88. Purba, R. A. The effective combination of blended learning and flipped classroom with Edmodo as a digital media innovation for learning from home. *J. Educ. Technol.* **2021** *5*(3). https://doi.org/10.23887/jet.v5i3.36210

Declaration of Interest Statement

Declaration of interests

☒ The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

☒The authors declare the following financial interests/personal relationships which may be considered as potential competing interests:

Cherisa Nantha reports article publishing charges was provided by King Mongkut's Institute of Technology Ladkrabang. Cherisa Nantha reports a relationship with King Mongkut's Institute of Technology Ladkrabang that includes: funding grants.