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# Enhancing creative problem-solving in Thai undergraduate education: The creative flipped classroom model

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**Abstract:** This study developed and validated a technology-enhanced flipped classroom framework, the CREATIVE Model, to enhance undergraduate students' creative problem-solving skills (CPSS). The CREATIVE Model, based on constructivist and constructionist learning theories, employed several digital platforms to promote active and collaborative learning. The study also examined students' academic achievement (AA) and CPSS when taught under the CREATIVE Model compared to traditional instruction. Using a research and development (R&D) design, the suitability of the CREATIVE Model was validated by seven experts. Subsequently, the model was implemented among 65 undergraduate students enrolled in a Digital Photography Technology Course, selected through cluster random sampling. The participants were divided into an experimental group (n=35) and a control group (n=30). The research instruments included (1) lesson plans based on the CREATIVE Model, (2) a multiple-choice achievement test with four options, and (3) a CPSS rubric. Data analysis involved descriptive statistics and one-way MANOVA. Results indicated that the lesson plans were rated as highly suitable (M = 4.45, SD = 0.74). Additionally, there was a statistically significant difference in students' AA and CPSS scores between the experimental and control groups, with the CREATIVE Model group scoring higher on both measures at the .05 significance level. The findings confirm that the CREATIVE Model effectively enhances undergraduate students' academic achievement and creative problem-solving skills.

***Keywords:*** *21st century skills, CREATIVE model, Creative problem-solving, Flipped classroom, Higher education, Learning management, Thailand.*

## 1. Introduction

Learning processes in open knowledge-based 21st-century societies have increasingly diversified to enhance lifelong learning skills and development. Regarding this, learner-centered education has gained widespread acceptance and adoption [1] due to its focus on the student's significant role in constructing their knowledge, skills, and competencies based on meaningful learning processes [2]. Also, according to Stoltz et al. [3], this inevitably entails transforming from passive to active learner [4] to support creative thinking, contemplate the depth of knowledge, and synthesize what is learned for systematic problem solving. These ideas have also been adopted in Thai national education policies, which aim to create a sustainable learning society as a foundation of national development [5].

Furthermore, the global educational reform movement also emphasizes 21st-century life and innovation skills [6]. Thailand, too, has launched educational reform [7] following other education leaders in setting directions for learner-centered management and instructional processes with digital technology [8]. One teaching pedagogy is the flipped classroom, which, since the merger of the Internet's use in teaching and learning, has become an essential approach in education, especially when physical classrooms are not practical or impossible, as was the case during the global COVID pandemic [9].


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Flipped classrooms, as the term implies, reverse the process of traditional classrooms [10] where students study instructional content and material related to the lesson before class, which transforms class periods and the classroom into 'learning spaces' ripe for discussion-based and peer-led learning through hands-on activities [11]. It helps promote active learning, allowing instructors to devise activities that encourage students to further develop their analytical and critical thinking skills, solve problems, and interact creatively with peers [12, 13].

Nonetheless, a pilot study in the Digital Photography Technology Course (DPTC) at King Mongkut's Institute of Technology, Ladkrabang, revealed some important issues impacting the Bachelor of Industrial Education program [14]. These comprise the findings that a large proportion of students came to class poorly prepared [15] instructors had to spend increased amounts of time lecturing rather than being able to run skill-building learning activities, and many students in the DPTC were working with relatively poor teamwork, analytical thinking, problem-solving, and creativity skills – limitations which appeared to be rooted in a weakness in applying knowledge to new or unfamiliar contexts. Other research on Thai higher education's current teaching and learning situation has also reported these issues. While the flipped classroom model (FCM) has been identified as a potentially effective pedagogical framework for addressing such teaching and learning problems [16], there is a clear gap relating to how it can be effectively designed and technology-supported so that the development of CPSS can be appropriately facilitated and monitored in the context of Thai higher education.

### *1.1. Research gap*

Even though the FCM has been thoroughly investigated in Western contexts as a vehicle for improving general academic performance and student engagement, a research gap remains regarding how this blended learning approach can be systematically applied in Southeast Asian higher education for the same aim, especially in Thailand. In particular, the literature often limits itself to considering the broad benefits of flipped classroom learning rather than empirically investigating its efficacy for improving specific high-order 21st-century skills such as creative problem-solving (CPS). Furthermore, a gap exists regarding how a specific suite of technologies (e.g., *Google Classroom* for management and *Kahoot* for interactive engagement) can be utilized in a cohesive pedagogical model that systematically improves high-order thinking skills such as CPS [17]. In response to this gap, this paper develops and empirically tests a Technology-Enhanced Flipped Classroom model grounded in constructivist and constructionist learning theories to systematically improve creative problem-solving skills in an undergraduate course taught in Thailand [18, 19].

The following research objectives (ROs), research questions (RQs), and hypotheses guide this experimental study:

### *1.2. Research Objectives (ROs)*

This study aimed to achieve the following objectives:

RO1: To develop an FCM integrated with technology using the CPSS process for undergraduate students.

RO2: To assess the suitability and quality of the learning model and lesson plans developed by experts.

RO3: To compare the students' academic achievement (AA) level taught by technology-based FCM and traditional methods.

RO4: To compare the CPSS of students receiving training with the technology-enriched FCM and the CPSS of students receiving training with traditional methods.

Research questions (RQs)

To guide the investigation, this paper sought to answer the following RQs:

RQ1: What is the structure of technology-enhanced FCM fostering CPSS?

RQ2: How appropriate are the developed learning models and lesson plans based on the views of the experts?

RQ3: Do students' AA differ between those taught with a technology-enhanced FCM and those taught with traditional instruction?

RQ4: Is there a CPSS difference between students taught via technology-enhanced FCM and students taught via traditional methods?

Hypotheses

Based on the ROs and the theoretical framework, the following hypotheses were formulated and tested:

*$H_1$: The lesson plans developed for the CREATIVE flipped classroom model will be rated by experts as having a high level of suitability for implementation.*

*$H_2$: There will be a statistically significant difference in the combined dependent variables (AA and CPSS) between students taught with the CREATIVE Model and those taught with traditional methods.*

*$H_3$: Students taught with the CREATIVE Model will demonstrate significantly higher AA than students taught with traditional methods.*

*$H_4$: Students taught with the CREATIVE Model will demonstrate significantly higher CPSS than students taught with traditional methods.*

## 2. Literature Review

The development of the conceptual framework establishes the theoretical foundation for the study by examining the core concepts of flipped classrooms and CPSS, and their integration into the proposed instructional FCM.

### *2.1. Conceptual Framework For a 21st Century Learning Model*

The CREATIVE Model is based on constructivist and constructionist perspectives, forming the solid basis for 21st-century learner-centered pedagogy. From Piaget's and Vygotsky's views, learning is an active and social process where students interpret new knowledge by connecting prior ideas to new experiences through interaction and reflection [3, 20]. Based on these notions, Papert's Constructionism further claims that learning is more meaningful when learners are actively involved in designing and constructing tangible objects to present their understanding of real-world contexts [21]. These theoretical underpinnings are synonymous with the flipped classroom approach, where learners acquire foundational knowledge before in-class sessions, thus allowing the face-to-face time to involve collaborative inquiry, construction, and evaluation of authentic projects [22, 23]. In this setting, instructors are no longer the deliverers of content knowledge but facilitators who support learners' cycles of inquiry, creation, and reflection, the circumstances conducive to creative problem-solving skills (CPSS) development. The CREATIVE Model, therefore, translates constructivist and constructionist ideas into a process-based, technology-supported sequence to methodically foster higher-order cognitive development and creativity in Thai higher education [24, 25].

### *2.2. Innovation and Learning Skills*

Educational reform in the 21st century is based on the idea that the knowledge and skills necessary for learners extend beyond core subjects to include essential life and innovation skills [26]. As such, learning to be creative and innovative has become an essential life skill, and the ability to think critically and solve problems. Communication and collaboration are important skills to address current societal and labor market challenges [27]. For the DPTC, creative problem-solving skills are important since theory and practice are integrated. Students should be able to apply both types of knowledge, adapt to the situation accordingly, and generate novel solutions through a flexible and challenging learning process.

Hence, students should acquire the skill of 'learning to learn' (L2L) [28] using technology as an important tool to search for knowledge and create work [29]. A learning process that allows students to take initiative, perform practical actions, and construct knowledge from experience should be core


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in helping students acquire essential skills and competence in the 21st century.

## 3. Methods

This study used three stages of the Borg and Gall Development Model [30]. This article focuses on Stage 2's Model Development and Stage 3's Model Dissemination and Implementation.

### *3.1. Model Development Stage*

This stage involved developing the technology-enhanced flipped classroom model (FCM) and using an expert evaluation seminar [11]. This session presented a preliminary model (Figure 1) and the lesson plans to a panel of experts in flipped classroom pedagogy, assessment, and digital photography technology instruction [31]. They evaluated the model's consistency and the lesson plans' appropriateness using an evaluation form developed by the researchers.

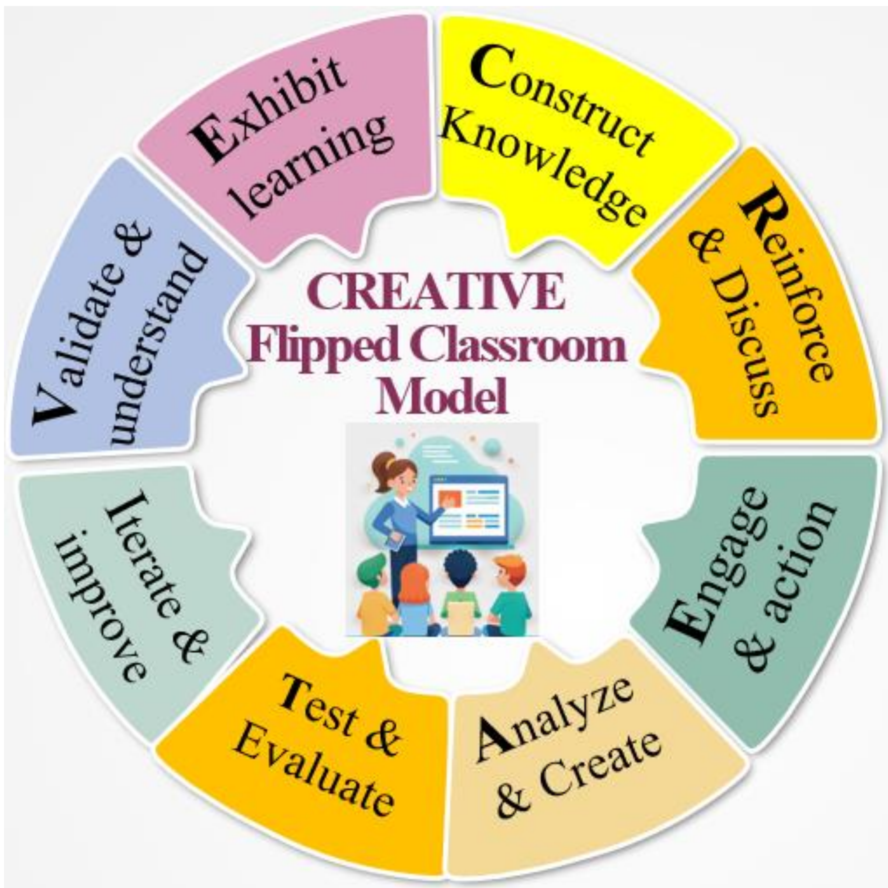


**Figure 1.**
The CREATIVE Flipped Classroom and CPSS Learning Model.

The intervention was formally structured as the CREATIVE Model, a technology-enhanced flipped classroom framework. The acronym 'CREATIVE' defines the sequential learning phases of the model, which are designed to scaffold the development of CPSS systematically. The phases are outlined in Table 1.

**Table 1.**
The CREATIVE Model Learning Phases.

| Phase | Model Letter | Description | Learning Context |
|---|---|---|---|
| Construct knowledge | C | Students study key concepts independently through curated online videos and resources via platforms such as Google Classroom [32]. | Pre-class / Out-of-class |
| Reinforce & discuss | R | The in-class sessions begin with interactive activities (e.g., Kahoot quiz) based on pre-class material to review concepts learned and stimulate discussion [33]. | In-class |
| Engage in Action | E | Students work collaboratively on hands-on projects and case studies that mandate the application of knowledge to realistic problems [34]. | In-class |
| Analyze & create | A | Teams assess challenges and develop innovative solutions [35] which they bring to life through creation or advocacy. | In-class |
| Test & evaluate | T | Students prototyping and testing their solutions, including peer evaluation, obtaining formative feedback [36]. | In-class |
| Iterate & improve | I | Students then revise their work based on the feedback provided and improve it over time, building resilience and the capability to think iteratively [37]. | In-class |
| Validate understanding | V | The instructor provides expert feedback and evaluates the learning process and products through the CPSS rubric [38]. | In-class / Post-class |
| Exhibit learning | E | Students present their final product, demonstrating their learning journey and creative thinking process behind their problem-solving to the class [39]. | Post-class |

*3.2. Instruments*

Lesson Plans: Course instructors validated four plans for content accuracy, language, and learning activities.

Lesson Plan Evaluation Form: A 5-level rating scale covering learning objectives, content, process, media/resources, and assessment. The IOC from five experts ranged from 0.67 to 1.00.

Achievement Test: A 4-multiple-choice test with an IOC from 0.80 to 1.00.

Creative Problem-Solving Skills Rubric: A 5-level rubric (1=Needs Improvement to 5=Excellent) with an IOC from 0.68 to 1.00 [40].

*3.3. Formative Evaluation & Tryout*

The lesson plans underwent a three-phase tryout.

Phase 1 (3 students & 1 instructor): Focused on content understanding from 5–10-minute video clips. Feedback led to adding subtitles and adjusting video speed.

Phase 2 (9 students & 1 instructor): Focused on media, duration, and activities. Feedback emphasized updating content for relevance and aligning assessment rubrics with the process.

Phase 3 (Tryout with 30 students): A full-scale tryout over 4 weeks (240 minutes/week) to test instrument quality. The procedure included a pre-test, implementation of the CREATIVE model, and a post-test. Content analysis of feedback led to further refinements.

*3.4. Model Dissemination and Implementation Stage*

This stage compared students' academic achievement and creative problem-solving skills in the flipped classroom (experimental) and traditional (control) groups.

Population and Sample: 120 undergraduate students enrolled in a second-semester DPT course. The sample, selected via cluster random sampling, consisted of 65 students, of whom 35 were assigned to the experimental group, while the remaining 30 were assigned to the control (traditional teaching) group.

*3.4.1. Instruments*

Flipped Classroom Lesson Plans: Four plans covering key topics.

Achievement Test: The refined test had a difficulty index ($p$) of 0.27–0.63, a discrimination index ($r$) of 0.27–0.67, and a reliability (Cronbach's $\alpha$) of 0.804.

Creative Problem-Solving Skills Rubric: The finalized rubric.

*3.5. Data Collection*

Data collection involved the following:

- Orientation on the flipped classroom process.
- Administration of a pre-test to both groups.
- Implement the flipped classroom and CPSS learning model for the experimental group over 4 weeks (240 minutes per session). Instructors observed and assessed skills using the rubric.
- Administration of a post-test to both groups.

*3.6. Data Analysis*

- Suitability of lesson plans was analyzed using mean (*M*) and standard deviation (*SD*).
- Differences in achievement and CPSS were analyzed using one-way MANOVA.

## 4. Results

*4.1. Model Development Stage*

The CREATIVE Model development underwent validation through expert evaluation (Table 2), confirming that the flipped classroom lesson plans demonstrated high quality and suitability for implementation. The overall evaluation yielded a high suitability score ($M$ = 4.45, $SD$ = 0.074), indicating strong expert consensus on the model's pedagogical soundness.

The expert validation is essential for the intervention's content validity and pedagogical strength. The highest ratings for *learning content* ($M$=4.56) and *learning process* ($M$=4.53) are particularly significant, as the experts confirmed the core pedagogical design. These included the stimulation sequence, peer coaching, action, and evaluation, effectively operationalizing the constructivist and constructionist principles underpinning the model [3, 4, 20]. The high score for *media and resources* ($M$=4.47) further validates the successful integration of technology (e.g., Google Classroom, Kahoot) as a scaffold for active learning, a key tenet of the flipped classroom approach [22]. This table confirms that the CREATIVE Model is not just a structural framework but a theoretically grounded and expert-approved pedagogical intervention ready for empirical testing.


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**Table 2.**
Expert Evaluation Results on the Suitability of the Flipped Classroom Lesson Plans.

| Item | M | SD | Interpretation |
|---|---|---|---|
| Lesson Plan Components | 4.35 | 0.109 | High |
| Learning Objectives | 4.43 | 0.088 | High |
| Learning Content | 4.56 | 0.111 | Highest |
| Learning Process | 4.53 | 0.073 | Highest |
| Media and Resources | 4.47 | 0.094 | High |
| Learning Assessment | 4.41 | 0.093 | High |
| Total | 4.45 | 0.074 | High |

### *4.2. Model Dissemination and Implementation Stage*

Comprehensive diagnostic checks were conducted before testing the primary hypotheses to ensure the data met all necessary assumptions for MANOVA. As summarized in Table 3, the data satisfactorily met all critical assumptions, ensuring the robustness and validity of subsequent analyses.

The data demonstrated acceptable univariate normality for both dependent variables, as indicated by the skewness and kurtosis values falling within acceptable ranges (±2). Crucially, the non-significant Box's M test ($p = .74 > .05$) confirmed the homogeneity of variance-covariance matrices, while the non-significant Levene's tests ($p = .97$ for achievement; p = .68 for creative problem-solving) supported the homogeneity of variances across experimental conditions. Furthermore, the correlation between dependent variables (.79) was sufficiently high to justify their simultaneous analysis in MANOVA while remaining below the multicollinearity threshold of 0.80. These rigorous diagnostic procedures establish a solid foundation for interpreting the intervention effects.

**Table 3.**
Preliminary Assumption Testing for MANOVA.

| Statistical Test | Normal Distribution | r | Box's M Test (Sig.) | Bartlett's Test (Sig.) | Levene's Test (Sig.) | |
|---|---|---|---|---|---|---|
| | Skewness | Kurtosis | | | | |
| Achievement | -0.28 | -1.68 | 0.79** | 0.74 | 0.000 | 0.97 |
| Creative Problem Solving | -0.51 | -1.08 | | | | 0.68 |
| Results | Normality | Normality | 0.79 < 0.80 | Sig. > α | Sig. < α | Sig. > α |

**Note:** *α = 0.05*.

A one-way MANOVA was utilized to ascertain the effect of the CREATIVE Model on the combined dependent variables of AA and CPSS. Results from Table 4 indicate a statistically significant difference between the experimental and control groups. The MANOVA results also provide strong empirical support for the effectiveness of the technology-enhanced CREATIVE Model. Given a minimal Wilks' Lambda value ($\Lambda = .057$) and a very large, highly significant F-statistic ($F = 500.102$, $p < .001$), the authors concluded that the model had a substantial, statistically significant effect on the linear combination of the two learning outcomes. Therefore, the overwhelming results allow us to reject the null hypothesis.

Further examination of the means confirms the practical importance of this result, with the experimental group performing significantly better on both AA (Exl $M$=89.90 versus *control* $M$=71.70) and *CPSS* (Exl $M$=68.77 versus *control* $M$=52.78). The significant 18-point difference in achievement suggests that the model resulted in a much deeper mastery of core subject knowledge. More crucially, the 16-point difference in CPSS is evidence that the model did more than rote learning and delivered an outcome of importance to higher education, achieving higher-order thinking skills (HOTS). This result is a direct consequence of the theoretical underpinning by 'flipping' direct instruction outside of class time, and preserving class time for collaborating, project-based activity (*action phase*), the model established the social-constructivist conditions for students to pursue and develop creative problem-solving [3]. The results indicate that the CREATIVE Model helps bridge the gap between theory and its creative, practical application.

These results strongly support H2, H3, and H4, confirming that the CREATIVE model significantly enhances AA and CPSS capabilities compared to traditional instructional approaches.

**Table 4.**
Mean, Standard Deviation, and MANOVA Results for Learning Outcomes by Group.

| Dependent Variable | Group | n | Scores (100) | F | Sig. |
|---|---|---|---|---|---|
| | | | M | SD | |
| Academic Achievement | Experimental | 35 | 89.90 | 2.30 | 500.10 |
| | Control | 30 | 71.70 | 2.33 | |
| Creative Problem-Solving Skills | Experimental | 35 | 68.77 | 6.21 | |
| | Control | 30 | 52.78 | 7.37 | |

**Note:** *Λ=0.057, F=500.102, Sig.= 0.000, α=0.05*, M = mean, SD = standard deviation.

## 5. Discussion

### *5.1. The CREATIVE Problem-Solving Learning Model*

The expert validation results (H1) demonstrate that the CREATIVE Model embodies sound educational design principles. The high ratings for learning content and process dimensions suggest that the model successfully operationalizes constructivist and constructionist theories into practical classroom activities [3, 4, 20]. The integration of technology received strong endorsement, aligning with contemporary educational frameworks that emphasize digital literacy as a core 21st-century competency [6].

The empirical results support the model's impact on student learning outcomes. The large effect size (Wilks' $\Lambda$ = .057) observed in the MANOVA strongly supports H2 and indicates that the CREATIVE Model substantially improves the targeted learning outcomes. This finding is particularly noteworthy given the challenging educational context and aligns with previous research demonstrating the effectiveness of well-designed flipped classroom approaches [27].

### *5.2. Theoretical Implications*

The success of the CREATIVE Model can be understood through its theoretical grounding in social constructivism and constructionism. The significant improvement in CPSS (H4) suggests that the model's phased approach, particularly the *Analyze & Create* and *Iterate & Improve* stages, effectively scaffolds the development of HOTS. This finding supports Papert's constructionist assertion that learning is enhanced when students construct tangible artifacts in supportive social environments [21].

The substantial gains in academic achievement (H3) demonstrate that the model successfully addresses common challenges in Thai higher education, where traditional lecture-based methods often dominate. By shifting content delivery to pre-class activities and utilizing class time for active learning, the CREATIVE Model creates the conditions for deeper cognitive processing and knowledge construction, consistent with Vygotsky's emphasis on social interaction in learning [41].

### *5.3. Practical Implications and Educational Significance*

The 18.2-point difference in academic achievement represents more than statistical significance; it reflects meaningful educational improvement that could substantially impact students' academic progression and future career readiness. Similarly, the 16-point enhancement in creative problem-solving skills indicates development in precisely the competencies that employers consistently identify as crucial for workplace success.

The model's success within a Digital Photography Technology Course indicates its broader applicability across other disciplines in Thai Higher Education. The CREATIVE phases provide a balanced framework for disciplinary tailoring while securing the pedagogical underpinnings that underpin the model's effectiveness. The structured yet flexible nature of the CREATIVE phases allows for disciplinary adaptation while maintaining the core pedagogical principles that drive its effectiveness.

*5.4. Methodological Considerations*

The methodological approach taken in this study strengthens the validity of the findings. Expert validation of the model prior to its implementation confirmed that it is pedagogically sound. Attention to the assumptions of MANOVA and the use of appropriate statistical controls provide increased confidence in the findings. Large effect sizes suggest that the improvements are educationally, as well as statistically, meaningful.

The successful implementation of the CREATIVE Model highlights that carefully designed flipped classroom methods can effectively meet the specific challenges and opportunities in Thai higher education contexts, offering a helpful template for educational innovation in comparable contexts.

*5.5. Creative Problem-Solving Skills Enhancement*

The reasons for significantly higher CPSS in the experimental group can be categorized according to the steps of the model. As it has been mentioned previously, systematic thinking, analysis, and use of ideas in practice were prioritized in this model. Creative interactions in the class and the use of technology at different steps developed the interest and motivation of students. Techniques such as brainstorming and small group discussions during the application of project ideas enabled students to work in teams creatively and collaboratively, be open to each other's ideas, and clearly articulate what they analyzed and solved. Additionally, students compared and contrasted concepts, analyzed and solved cases systematically, considered more than one solution, and evaluated the most appropriate one through analysis. When presenting their work, they used different presentation formats, such as mind maps. The students could express (communicate) openly and clearly the outcomes they comprehended collaboratively and demonstrate their work. While working collaboratively, students were responsible and demonstrated the ability to share gained knowledge as well as synthesize it.

## 6. Conclusions

This study demonstrated that the technology-enhanced CREATIVE Model developed in this research effectively improved undergraduate students' academic achievement and creative problem-solving skills in a higher education Digital Photography Technology Course. The differences in the results were statistically significant; therefore, the research hypotheses were supported. The findings suggest that the flipped classroom approach is suitable for higher education, where students are required to take greater responsibility for their learning and participate more actively in the learning process. The CREATIVE Model, combined with stimulation, peer coaching, action, and evaluation, facilitates students' deep learning. This approach enables them to think critically, analyze problems, solve issues, and construct knowledge systematically. Incorporating technology tools such as Google Classroom and Kahoot can enhance the value of the flipped classroom model by increasing students' motivation and engagement, leading to more interactive learning experiences. Consequently, as the proposed model improved academic achievement and creative problem-solving skills, it is highly recommended that this model be implemented in higher education, particularly in subjects aimed at developing creative problem-solving and other essential skills required in the 21st century.

## Institutional Review Board Statement:

This research involved human participants and was conducted in accordance with the Declaration of Helsinki, with all participants providing informed consent. However, the study protocol was exempt from institutional ethics review under Thailand's TSRI Guidance No. 3(3), as the research was conducted anonymously, did not collect identifiable information, involved no intervention, and posed no risk to participants' physical or mental integrity [42].

## Transparency:
The authors confirm that the manuscript is an honest, accurate, and transparent account of the study; that no vital features of the study have been omitted; and that any discrepancies from the study as planned have been explained. This study followed all ethical practices during writing.

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## References
[1] F. Bulusan, K. M. A. CABACANG, M. G. C. Duero, R. A. L. Malate, J. F. Mangao, and D. P. Parcon, "Emerging strategies in imbibing learner-centered education in the 21st century language classrooms: A decade scoping review in Southeast Asia," *International Journal of Linguistics, Literature and Translation*, vol. 8, no. 6, pp. 46-57, 2025. https://doi.org/10.32996/ijllt.2025.8.6.5
[2] S. Donkoh and A. Amoakwah, "The use and challenges of learner-centered pedagogy: Basic school teachers' perspective," *European Journal of Education and Pedagogy*, vol. 5, no. 1, pp. 66-71, 2024. https://doi.org/10.24018/ejedu.2024.5.1.774
[3] T. Stoltz, U. Weger, and M. da Veiga, "Consciousness and education: contributions by Piaget, Vygotsky and Steiner," *Frontiers in Psychology*, vol. 15, p. 1411415, 2024. https://doi.org/10.3389/fpsyg.2024.1411415
[4] M. Alomá Bello, L. M. Crespo Díaz, K. González Hernández, and N. Estevez Perez, "Cognitive and pedagogical foundations of active learning," *Mendive-Revista de Educacion*, vol. 20, no. 4, p. 1353, 2022.
[5] P. Phumphongkhochasorn, P. S. Damnoen, T. Suwannaprateep, and U. Phoomparmarn, "National educational standards and the improvement of Thai education system with world class," *Asia Pacific Journal of Religions and Cultures*, vol. 5, no. 1, pp. 75-86, 2021.
[6] F. Syahriani, F. Yufriadi, and Fismanelly, "Empowering the future: Innovative education strategies for global skills in the context of the golden generation 2045," *International Journal of Applied Educational Research*, vol. 1, no. 2, pp. 121 - 134, 2023. https://doi.org/10.59890/ijaer.v1i2.1077
[7] U. Sihawong and S. Phusee-orn, "Developing a model to enhance junior high school teacher 21st century learning management competencies," *Journal of Education and Learning*, vol. 13, no. 1, pp. 101-110, 2024.
[8] P. Y. Chan, P. K. Cheah, and Y. O. Choong, "Digital era learner-centered leadership and teachers' efficacy: the mediating role of teachers' professional learning," *Journal of Professional Capital and Community*, 2024. https://doi.org/10.1108/JPCC-06-2024-0090
[9] B. Plangsorn and S. Phupan, "The effect of flipped classroom on undergraduate students' learning outcomes: A meta-analysis," in *EdMedia+ Innovate Learning (pp. 1058-1064). Association for the Advancement of Computing in Education (AACE)*, 2024.
[10] R. Mazlan, Z. Mahamod, and K. A. Jamaluddin, "Comprehensive structured review of implementing flipped classroom approaches in education," *Journal of Education and Learning (EduLearn)*, vol. 19, no. 3, pp. 1651-1661, 2025. https://doi.org/10.11591/edulearn.v19i3.22655
[11] P. Pimdee, A. Sukkamart, C. Nantha, T. Kantathanawat, and P. Leekitchwatana, "Enhancing Thai student-teacher problem-solving skills and academic achievement through a blended problem-based learning approach in online flipped classrooms," *Heliyon*, vol. 10, no. 7, p. e29172, 2024. https://doi.org/10.1016/j.heliyon.2024.e29172
[12] N. Phurikultong and T. Kantathanawat, "Flipping the undergraduate classroom to develop student analytical thinking skills," *Emerging Science Journal*, vol. 6, no. 4, pp. 739-757, 2022. https://doi.org/10.28991/ESJ-2022-06-04-06
[13] D. P. Comber and M. Brady-Van den Bos, "Too much, too soon? A critical investigation into factors that make Flipped Classrooms effective," *Higher Education Research & Development*, vol. 37, no. 4, pp. 683-697, 2018. https://doi.org/10.1080/07294360.2018.1455642

[14] V. Buntornwon and K. Sriwisathiyakun, "Project-based blended learning activities in fundamental digital photography class enhancing technical and creativity skills of vocational students," in *2023 7th International Conference on Information Technology (InCIT) (pp. 309-314). IEEE*, 2023.
[15] S. Shibukawa and M. Taguchi, "Exploring the difficulty on students' preparation and the effective instruction in the flipped classroom: A case study in a physiology class," *Journal of Computing in Higher Education*, vol. 31, pp. 311-339, 2019. https://doi.org/10.1007/s12528-019-09220-3
[16] M. P. Larson and J. Linnell, "Are students coming to class prepared? The importance of pre-class learning in a flipped classroom," *Issues in Accounting Education*, vol. 38, no. 3, pp. 183-205, 2023. https://doi.org/10.2308/ISSUES-2021-099
[17] A. Aibar-Almazán, Y. Castellote-Caballero, M. d. C. Carcelén-Fraile, Y. Rivas-Campo, and A. M. González-Martín, "Gamification in the classroom: Kahoot! As a tool for university teaching innovation," *Frontiers in Psychology*, vol. 15, p. 1370084, 2024. https://doi.org/10.3389/fpsyg.2024.1370084
[18] T. Jantakoon and P. Piriyasurawong, "Flipped classroom instructional model with mobile learning based on constructivist learning theory to enhance critical thinking (FCMOC model)," *Journal of Theoretical and Applied Information Technology*, vol. 96, no. 16, pp. 5607-5614, 2018.
[19] S. Wongchiranuwat, C. Samat, I. Kanjug, and S. Wattanachai, "A designing framework for flipped classroom learning environment model combined with augmented reality to enhance creative thinking in product design for high school students," in *International Conference on Innovative Technologies and Learning (pp. 206-218). Cham: Springer International Publishing*, 2021.
[20] A. L. Brown, K. E. Metz, and J. C. Campione, *Social interaction and individual understanding in a community of learners: The influence of Piaget and Vygotsky. Piaget Vygotsky*. New York: Psychology Press, 2013.
[21] I. Levin, A. L. Semenov, and M. Gorsky, "Smart learning in the 21st century: Advancing constructionism across three digital epochs," *Education Sciences*, vol. 15, no. 1, p. 45, 2025. https://doi.org/10.3390/educsci15010045
[22] L. Abeysekera and P. Dawson, "Motivation and cognitive load in the flipped classroom: definition, rationale and a call for research," *Higher Education Research & Development*, vol. 34, no. 1, pp. 1-14, 2015. https://doi.org/10.1080/07294360.2014.934336
[23] P. Baepler, J. Walker, and M. Driessen, "It's not about seat time: Blending, flipping, and efficiency in active learning classrooms," *Computers & Education*, vol. 78, pp. 227-236, 2014. https://doi.org/10.1016/j.compedu.2014.06.006
[24] C.-L. Lai and G.-J. Hwang, "A self-regulated flipped classroom approach to improving students' learning performance in a mathematics course," *Computers & Education*, vol. 100, pp. 126-140, 2016. https://doi.org/10.1016/j.compedu.2016.05.006
[25] M. L. Sein-Echaluce, Á. Fidalgo-Blanco, A. M. Balbín, and F. J. García-Peñalvo, "Flipped Learning 4.0. An extended flipped classroom model with Education 4.0 and organisational learning processes," *Universal Access in the Information Society*, vol. 23, pp. 1001-1013, 2024. https://doi.org/10.1007/s10209-022-00945-0
[26] L. I. González-Pérez and M. S. Ramírez-Montoya, "Components of Education 4.0 in 21st century skills frameworks: systematic review," *Sustainability*, vol. 14, no. 3, p. 1493, 2022. https://doi.org/10.3390/su14031493
[27] J. O'Flaherty and C. Phillips, "The use of flipped classrooms in higher education: A scoping review," *The internet and Higher Education*, vol. 25, pp. 85-95, 2015. https://doi.org/10.1016/j.iheduc.2015.02.002
[28] V. Zydziunaite, L. Kaminskiene, V. Jurgile, and E. Jezukeviciene, "Learning characteristics in educational interactions between teacher and student in the classroom," *European Journal of Contemporary Education*, vol. 11, no. 1, pp. 213–240, 2022.
[29] S. C. Chan, W. T. Chan, and J. J. Xiao, "Learning how to learn: The relationships between students' learning-to-learn (L2L) competence, learning self-efficacy, and achievement in project-based learning," *Journal of Education for Business*, vol. 100, no. 2, pp. 81-90, 2025. https://doi.org/10.1080/08832323.2024.2449506
[30] S. A. N. Larasati, J. A. Rahmatin, R. Alawiyah, and S. Rahayu, "Literature review: The application of the borg & gall development model in science learning," *Indonesian Journal of Educational Innovation*, vol. 1, no. 1, pp. 1-7, 2025.
[31] S. Zhao, W. Liu, and Y.-J. Lan, "The effects of a flipped classroom approach on older adult students' performance in digital photography," *Educational Gerontology*, vol. 51, no. 7, pp. 792-808, 2025. https://doi.org/10.1080/03601277.2024.2410531
[32] P. D. Deep, Y. Chen, N. Ghosh, and M. S. Rahaman, "The influence of student–instructor communication methods on student engagement and motivation in higher education online courses during and after the COVID-19 pandemic," *Education Sciences*, vol. 15, no. 1, p. 33, 2024. https://doi.org/10.3390/educsci15010033
[33] Z. Zainuddin, S. K. W. Chu, and C. J. Perera, *Gamification in a flipped classroom: Pedagogical methods and best practices*. Singapore: Springer Nature Singapore, 2024.
[34] O. Omelianenko and N. Artyukhova, "Project-based learning: Theoretical overview and practical implications for local innovation-based development," *Economics and Education*, vol. 9, no. 1, pp. 35-41, 2024.
[35] D. Mariani and U. Dewi, "Literature study: The effect of the problem-based learning model assisted by the flipped classroom on mathematical creative thinking ability," *Jurnal Pendidikan Indonesia*, vol. 6, no. 1, pp. 75-90, 2025.
[36] J. Wang and H. Liu, "Reform and practice of the cross-integration teaching model: A case study of visual communication design," *PLoS One*, vol. 20, no. 7, p. e0327813, 2025. https://doi.org/10.1371/journal.pone.0327813


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[37] S. I. Rooney, C. E. King, L. Christian, M. Kavdia, J. C. Kays, and S. F. Shady, "Identifying and overcoming barriers to classroom engagement in biomedical engineering education," *Biomedical Engineering Education*, vol. 5, pp. 107–120, 2025. https://doi.org/10.1007/s43683-025-00176-8

[38] P. Pimdee, O. Wuttikamonchai, A. Sukkamart, C. Meedee, and S. Meekhobtong, "Improving Thai undergraduate students' web design skills for smartphones through a collaborative blended learning approach," *Frontiers in Education*, vol. 10, 2025. https://doi.org/10.3389/feduc.2025.1522793

[39] C. Janpirom, S. Tuntiwongwanich, P. Pimdee, C. Kulworatit, and S. Moto, "Lecturers' perspectives on undergraduate students' innovative thinking skills and creative problem-solving skills: A comparative needs analysis," *International Journal of Instruction*, vol. 18, no. 3, pp. 121-140, 2025.

[40] N. Wannapiroon and P. Pimdee, "Thai undergraduate science, technology, engineering, arts, and math (STEAM) creative thinking and innovation skill development: A conceptual model using a digital virtual classroom learning environment," *Education and Information Technologies*, vol. 27, no. 4, pp. 5689-5716, 2022. https://doi.org/10.1007/s10639-021-10849-w

[41] K. S. Taber, *Mediated learning leading development—The social development theory of Lev Vygotsky. In B. Akpan & T. J. Kennedy (Eds.), Science education in theory and practice.* Cham, Switzerland: Springer, 2025.

[42] R. Lieophairot, N. Rojniruttikul, and S. Chaveesuk, "Factors influencing rail service passenger loyalty among older Thai adults," *Sustainability*, vol. 17, no. 18, p. 8240, 2025. https://doi.org/10.3390/su17188240


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