DEVELOPING A TECHNOLOGY-ENHNCED FLIPPED CLASSROOM MODEL TO PROMOTE CREATIVE PROBLEM-SOLVING SKILLS IN UNDERGRADUATE EDUCATION: AN ANALYSIS OF CURRENT CONDITTIONS AND CHALLENGES

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ABSTRACT

The rapid evolution of digital technologies and shifting pedagogical paradigms have underscored the need for innovative learning models in higher education, particularly in fields that require applied problem-solving competencies. This study examines the current conditions, challenges, and development guidelines for a technology-enhanced flipped classroom learning model designed to foster creative problem-solving skills among undergraduate students in industrial vocational programs. Grounded in the Input–Process–Output (IPO) framework, the research addresses three primary objectives: (1) to analyze the existing teaching practices and instructional challenges faced by university instructors that affect students' creative problem-solving development; (2) to examine student perspectives and learning behaviors that influence the flipped classroom model's effectiveness; and (3) to propose development guidelines for an effective flipped classroom model that enhances students' creative problem-solving abilities-a total of 215 participants including university instructors and undergraduate students were selected using stratified random sampling. Data were collected through a five-point Likert scale questionnaire with strong content validity (CVI ranging from 0.80 to 1.00) and high internal consistency (Cronbach's alpha = 0.93). The study was conducted in three phases. Phase 1 analyzed the current instructional conditions and problems of instructors; Phase 2 investigated student opinions and learning behaviors; and Phase 3 assessed behavioral learning data in the Digital Photography Technology course. The findings provide an evidence-based foundation for developing a structured, technology-driven flipped classroom model tailored to enhance creative problem-solving skills within the context of higher education and work-integrated learning environments.

Keywords: Flipped classroom, Creative problem-solving, Technology-enhanced learning, Work-integrated learning, Instructional design

I. INTRODUCTION

In recent years, many countries worldwide have developed educational strategies that emphasize inclusivity and equity, aiming to ensure lifelong access to quality learning for all. These efforts align with the United Nations' Sustainable Development Goals (SDGs 2030), which influence global labor market demands that increasingly prioritize future-oriented skills such as analytical thinking, creative problem-solving, and the ability to collaborate effectively with others (World Economic Forum, 2024, online). Amid the complexity and volatility of the modern world characterized by the BANI (Brittle, Anxious, Nonlinear, and Incomprehensible) framework education systems must adapt their instructional approaches to equip learners with competencies responsive to these dynamic transformations (UNESCO, 2015, pp. 113-114). In Thailand, this imperative is particularly salient, given the country's 20-Year National Strategy (2017-2037) and its participation in regional economic cooperation. As a result, there is an urgent need to accelerate human capital development in alignment with the evolving demands of the industrial sector.

In recent years, higher education and vocational education have introduced innovative instructional approaches, such as active learning and student-centered learning, emphasizing learner engagement and the development of higher order thinking skills. However, most learning models still lack a systematic integration of technology into teaching and learning processes. Moreover, these approaches are often disconnected from real-world workplace contexts, resulting in suboptimal development of students' creative problem-solving skills and falling short of the intended learning outcomes (Kahiigi et al., 2011, pp. 338-346).

The flipped classroom model is an internationally recognized instructional innovation that emphasizes student-centered learning by encouraging learners to study foundational content independently outside the classroom, while using in-class time for activities that promote analytical thinking, discussion, and creative problem-solving (Bergmann & Sams, 2012, pp. 35-50; Tucker, 2020, pp. 7-8). This approach fosters greater student engagement and transforms the role of instructors from knowledge transmitters to facilitators of learning. However, the development and implementation of flipped classroom models in Thailand remain limited, particularly in terms of systematically integrating technology to effectively support the development of creative problem-solving skills. Therefore, there is a lack of empirically grounded, context-specific instructional models designed to meet the needs of Thai higher education institutions collaborating with industry (Mulder, 2017, pp. 739-742).

This research presented three objectives as follows: The first objective is to examine the current instructional conditions and challenges faced by university instructors that influence the development of students' creative problem-solving skills. The second objective is to investigate students' opinions and learning behaviors that affect the effectiveness of the flipped classroom model. Lastly, the objective is to propose development guidelines for an effective technology-enhanced flipped classroom model in the context of Thai higher education. This research aims to investigate and develop a technology-enhanced flipped classroom learning model that fosters creative problem-solving skills in undergraduate students.

II. LITERATURE REVIEW

In the context of higher education in Thailand, the Thai Qualifications Framework for Higher Education (TQF: HEd) was developed to enhance the quality of tertiary education by establishing a structured progression of qualification levels and specifying learning outcome standards across five core domains: ethics and moral reasoning, knowledge, cognitive skills, interpersonal skills and responsibility, and numerical analysis, communication, and information technology skills. However, the implementation of TQF: HEd continues to face challenges, particularly in the assessment and evaluation of student learning outcomes, most notably in the area of creative problem-solving skills, which are considered critical for success in the 21st century.

Instructional System Design (ISD) plays a crucial role in developing effective teaching and learning processes. One of the most widely accepted frameworks in this domain is the ADDIE model, which consists of five key phases: Analysis, Design, Development, Implementation, and Evaluation. In addition to ADDIE, other well-established models such as those proposed by Dick and Carey, Morrison, Ross, Kemp and Kalman, and Gerlach and Ely emphasize systematic instructional design tailored to specific learning contexts (Dick & Carey, 2015, pp. 218-243; Gerlach & Ely, 1980, pp. 200-238; Kemp et al., 2011, pp. 136-155; Morrison et al., 2001, pp. 79-83). Within the context of flipped classroom learning, which emphasizes self-directed study outside the classroom and uses in-class time for higher-order thinking activities and peer interaction, instructional system design is supported by the strategic integration of digital resources to promote creative problem-solving skills. In this regard, the conceptual frameworks of (Paul & Elder, 2006, pp. 19-22) highlight key elements of creative problem-solving, including problem identification, hypothesis formulation, experimentation, and the generation of novel and contextually appropriate solutions.

III. RESEARCH METHODOLOGY

This study focuses on the development of a technology-enhanced flipped classroom learning model designed to foster creative problem-solving skills among undergraduate students. The study integrates three key frameworks: the Instructional System Design (ISD) model-comprising Input, Process, Output, and Feedback components; the Thai Qualifications Framework for Higher Education (TQF: HEd); and the flipped classroom approach, which emphasizes self-directed learning outside the classroom and the use of in-class time for analytical thinking, collaborative problem-solving, and knowledge co-construction. Furthermore, the study incorporates the theoretical foundations of (Paul & Elder, 2006, pp. 19-22) to inform both the design process and data analysis, particularly in relation to fostering creativity and innovation.

The research targets two main participant groups: university instructors and undergraduate students. In Phase 1, purposive sampling was used to select five instructors from the School of Industrial Education and Technology at King Mongkut's Institute of Technology Ladkrabang. The selected instructors had over three years of teaching experience in the Digital Photography Technology course. In Phase 2, the target population included 450 undergraduate students who had previously taken the same course in the second semester of the 2023 academic year. Based on Yamane formula (Yamane, 1973, pp. 368-391) the sample size was determined to be 215 students, selected through stratified random sampling.

The research process was divided into two main phases. Phase 1 focused on investigating the current conditions and challenges in instructional management. Data was collected through a structured interview protocol developed based on a review of related theories and frameworks, including the TQF: HEd, ISD, flipped classroom learning, and creative problem-solving. The interview consisted of four sections: (1) respondent demographics, (2) current teaching challenges, (3) in-depth questions aligned with ISD components, and (4) recommendations for developing an instructional model. Data were analyzed using content analysis via ATLAS.ti 7™, which facilitated keyword extraction and thematic categorization. Phase 2 investigated students' opinions and learning behaviors using a questionnaire developed from Phase 1 findings. The instrument included four sections: (1) respondent demographics, (2) 25 items on teaching challenges in the Digital Photography Technology course, (3) 18 items measuring learning behavior, and (4) open-ended suggestions. Instrument quality was assessed using the Index of Item-Objective Congruence (IOC), with values ranging from 0.80 to 1.00. Reliability was confirmed using Cronbach's Alpha, yielding coefficients of 0.97 and 0.93 for the respective scales.

Data collection was conducted in person between November 4 and 20, 2023, and all 215 questionnaires were returned, representing a 100% response rate. The data were analyzed using descriptive statistics, including mean, standard deviation, frequency, and percentage, to address the research objectives comprehensively.

The findings of this study are expected to contribute to the development of a technology-enhanced flipped classroom learning model aimed at enhancing creative problem-solving skills among undergraduate students. The proposed model is anticipated to be applicable to the instructional context of the Digital Photography Technology course, as well as other related subjects in higher education. Ultimately, this model aims to support the cultivation of a workforce equipped with competencies that align with industry demands and are adaptable to the rapid transformations of the modern world shown as Figure 1.

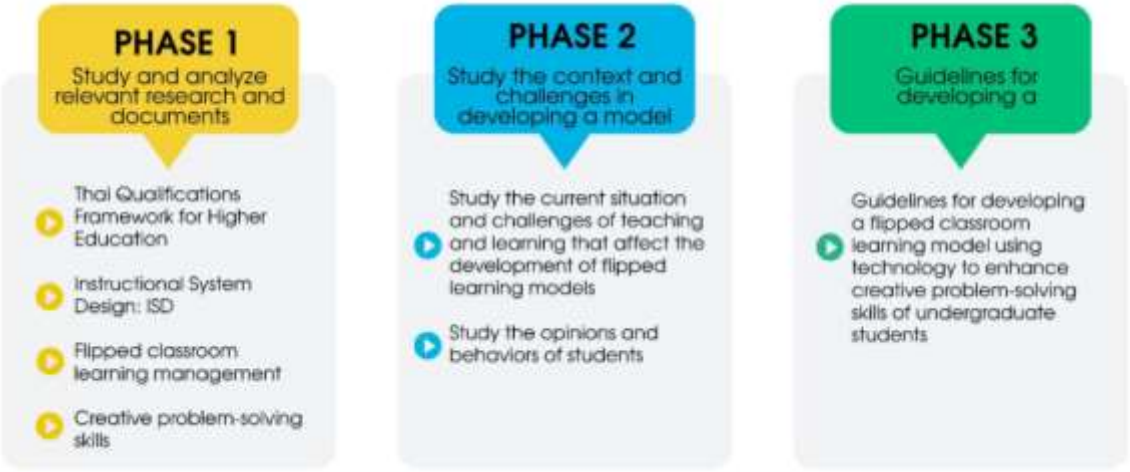

Figure 1: Phases of research process

IV. RESULTS

Phase 1: An Investigation into the current conditions and challenges of instructional practices among the university instructor's summary of findings

1. General background information

Among the five participants, the majority were male (3 individuals), accounting for 60%. Most respondents were aged between 41 and 50 years (two individuals, 60%). Regarding educational qualifications, 60% held doctoral degrees (two individuals). Two participants (60%) held academic positions. Most participants indicated that they had prior exposure to concepts related to creative problem-solving skills and the flipped classroom approach, particularly in the context of assessment and evaluation of learning outcomes (60%).

2. Information on the current conditions and challenges of instructional practices among university instructors

The results are presented in Table 1, as follows:

Table 1: A Comparison of the conditions and challenges in teaching and learning management among instructors

	Status	Problem
Input	**Course content dimension**	
	- Course content	- The instructional content outlined in the learning plan was extensive.
	Various instructional media were integrated into the course, including video clips, system demonstrations, instructional handouts, international textbooks, PowerPoint presentations, and information retrieval websites.	- Either instructional video materials were not provided or, when available, were too lengthy to be effectively applied to all topics covered in the course. - Case studies were presented based on each instructor's personal experiences.
	Student dimension	
	- Pre-instructional knowledge included foundational concepts and principles of photography, clarification of the course syllabus and instructional expectations, and fundamental understanding of image composition.	- Lacked fundamental skills in photographic principles - Lacked preparation prior to attending class Lacked a sense of responsibility - Demonstrated low motivation and enthusiasm for learning - Lacked teamwork skills, analytical thinking, problem-solving ability, and creativity in developing new systems
	Teaching faculty dimension	
	- The instructor demonstrated preparedness prior to teaching.	- There was no pre-assessment of students' knowledge prior to instruction.
	- There was evidence of instructional planning and course design.	- Few in-class learning activities were implemented. - Student participation in classroom activities was limited.
	- The instructional approach relied on lectures and case study presentations.	- Instructional materials varied and were individually developed by each instructor.

Table 1: (continued) A Comparison of the conditions and challenges in teaching and learning management among instructors

	Status	Problem
	Learning environment dimension	
	- The class followed a one-way lecture based format. - There were approximately 80 students per classroom.	- The space available for lighting setups in photography sessions was limited. - The number of students was relatively high.
	Learning activity design dimension	
Process	- Most in-class instruction relied heavily on lectures, with additional input from instructor-provided case studies and personal teaching experiences.	- There was insufficient instructional time allocated for providing consultation and feedback on students' group projects, which may have hindered effective supervision and formative assessment.
	- Group-based assignments were designed to reflect the characteristics of case studies previously presented during lectures.	- Some instructors do not include classroom activities. - Group work was often dominated by a few active participants, while meaningful consultation and collaboration among team members were lacking.
	- Out-of-class instructional activities primarily involved group projects and individual homework or practice exercises.	- Although students were required to undertake fieldwork and share the issues they encountered with their classmates, the activity did not elicit strong participation or meaningful interaction from their peers.

Table 1: (continued) A comparison of the conditions and challenges in teaching and learning management among instructors

	Status	Problem
	Assessment and evaluation	
Output	- The instructor assessed student performance through homework, assigned tasks, group work, in-class quizzes, midterm and final examinations, projects, and class attendance. - The evaluation was conducted using a norm-referenced grading system.	- This approach limited the ability to assess students' applied skills and did not reflect the full scope of their performance in real-world task execution.
	Outcome	
	- The students' scores were normally distributed.	- A lack of hands-on experience in system design hindered students' ability to conceptualize processes holistically. This gap negatively impacted their teamwork, innovation, and critical problem-solving skills, as reflected in their project assessment scores and performance during presentation-based inquiries.
Feedback	**Revise**	
	- Assessment data from the Office of the Registrar were reviewed during departmental meetings to guide instructional improvement and problem-solving initiatives.	

Phase 2: Study of students' opinions and learning behaviors. The findings can be summarized as follows

1. General information of the respondent's participant demographics and academic program distribution

The study involved a total sample of 215 undergraduate students, with the majority being female (141 participants or 65.58%) and the remainder male (74 participants or 34.42%). As shown in Figure 2, all participants were enrolled in the Bachelor of Industrial Education program. Additionally, they took the Digital Photography Technology course shown as Figure 3. The sample represented three academic disciplines; Architecture: 73 participants (33.95%), Interior Environmental Design: 67 participants (31.16%), Design Innovation and Technology: 75 participants (34.88%) This distribution reflects a diverse yet balanced representation across relevant design-focused disciplines, providing a meaningful context for evaluating the relevance and applicability of the course in supporting creative problem-solving skills within industrial education.

Figure 2: Digital technology curriculum management activities

Figure 3: An undergraduate student in instructional management in the digital photography technology course

2. Undergraduate students' opinion data regarding the current conditions and problems in instructional management in the digital photography technology course

Perceptions of the Current Instructional Conditions in the Digital Photography Technology Course An analysis of student perceptions regarding the current instructional conditions in the Digital Photography Technology course revealed that, overall, responses were rated at a high level ($\overline{x}$ = 4.20, SD = 0.73). When categorized by specific dimensions, the findings provide deeper insights into key aspects including instructional activity design, assessment evaluation, learning environment, content aspect, learner, and instructor, influencing the teaching and learning process as shown in Table 2.

Instructional activity design

In the area of instructional activity design, student perceptions were rated at a high level overall ($\bar{x}$ = 4.08, SD = 0.72). However, a closer examination of specific sub-factors revealed several critical issues; A lack of in-class activities that encourage students to practice thinking and problem-solving skills was identified as a major concern, receiving the highest rating ($\bar{x}$ = 4.41, SD = 0.62), indicating a high level of perceived deficiency. The absence of differentiated instruction that considers individual learning differences was also rated highly ($\bar{x}$ = 4.25, SD = 0.62), suggesting that teaching practices do not sufficiently address learner diversity. Additionally, instruction was found to lack a clear, step-by-step progression in teaching photographic techniques, which received a moderate rating ($\bar{x}$ = 3.87, SD = 0.77), indicating room for improvement in content sequencing and instructional clarity. These findings suggest that while instructional activities are generally viewed positively, there remain significant gaps in the design and delivery of activities that support deep learning, skill application, and learner-centered approaches.

Table 2: Perceptions of the current instructional conditions in the Digital Photography Technology course

Instructional management problems in the digital photography technology course	$\bar{x}$	SD	Level of problems
Instructional activity design dimension			
1. Lack of variety in teaching methods	3.81	0.79	Moderate
2. Instruction that does not consider individual differences	4.25	0.68	High
3. Failure to follow a sequential approach to teaching photography	3.87	0.77	Moderate
4. Lack of activities that engage students in practicing thinking and problem-solving skills during class sessions	4.41	0.62	High
Total	4.08	0.72	**High**
Assessment and evaluation dimension			
5. Emphasis on summative assessment through final examinations	4.70	0.51	Very high
6. Absence of pre-assessment to evaluate students' prior knowledge	4.02	0.92	High
7. Evaluation criteria that do not align with students' actual learning conditions	4.29	0.83	Very high
8. Lack of diverse assessment tools for measuring learning outcomes	4.36	0.57	High
Total	4.34	0.71	**High**
Learning environment dimension			
9. Excessive number of students per class group	4.02	0.71	High
10. Classroom conditions that are not conducive to group-based learning methods	3.83	0.76	Moderate
11. Outdated laboratory facilities that are inadequate for supporting current technologies	3.91	0.81	Moderate
Total	3.92	0.76	**High**

Table 2: (continued) Perceptions of the current instructional conditions in the Digital Photography Technology course

Instructional management problems in the digital photography technology course	$\bar{x}$	SD	Level of problems
Total	3.92	0.76	**High**
The content aspect dimension			
12. Course content does not align with the course description	4.49	0.70	High
13. Examples or case studies used in the course content lack variety	4.43	0.66	High
14. No new subject matter has been added to the course content	4.46	0.66	High
Total	4.46	0.67	**High**
Learner dimension			
15. Insufficient foundational knowledge	4.50	0.66	Very high
16. Lack of motivation to attend the Digital Photography Technology course	4.51	0.73	Very high
17. Lack of effort in completing exercises independently	4.32	0.83	High
18. Lack of enthusiasm in participating in classroom activities	4.04	0.82	High
19. Lack of responsibility in completing assigned tasks	3.99	0.79	Moderate
20. Lack of systematic thinking in problem-solving	4.38	0.69	High
Total	4.29	0.75	**High**
Instructor dimension			
21. Lack of communication regarding learning objectives for each class session	3.90	0.65	Moderate
22. Limited opportunities for students to ask questions during class	4.46	0.66	High
23. Insufficient time provided for student consultation outside of class	4.04	0.82	High
24. Lack of motivation-building strategies for students	4.05	0.88	High
25. Negative attitudes toward students who are unprepared for class	4.11	0.91	High
Total	4.11	0.78	**High**
In total	4.20	0.73	**High**

Assessment and evaluation

In the area of assessment and evaluation, the overall student perception was rated at a high ($\bar{x}$ = 4.34, SD = 0.71), indicating general satisfaction with the role of assessment in the instructional process. However, analysis of the subcomponents revealed notable concerns that reflect limitations in current assessment practices. The most critical issue identified was the heavy emphasis on end-of-semester examinations as the primary method of evaluating student learning outcomes, which received the highest mean score ($\bar{x}$ = 4.70, SD = 0.51). This suggests that summative assessment dominates the instructional process, potentially at the expense of formative and performance-based assessments that foster continuous learning and skill application. Another key finding was the limited use of diverse assessment tools, with a mean score of ($\bar{x}$ = 3.36, SD = 0.57). This indicates a lack of variety in evaluation methods such as project-based assessments, peer evaluations, presentations, and reflective tasks which are essential for capturing complex learning outcomes, particularly in creative and applied fields like digital photography. Additionally, the misalignment between assessment criteria and the real-life contexts of learners was also highlighted ($\bar{x}$ = 4.29, SD = 0.83). This points to a disconnect between theoretical expectations and students' practical learning environments, reducing the relevance and authenticity of assessment results. Collectively, these findings underscore the need for a more balanced and contextualized assessment approach, one that incorporates both summative and formative methods, utilizes varied tools, and aligns evaluation criteria with authentic learning experiences to effectively support creative problem-solving and deeper learning outcomes.

Learning environment

The overall perception of students regarding the learning environment was rated at a high level ($\bar{x}$ = 3.62, SD = 0.58). However, when examining the subcomponents in detail, several specific issues were identified. The most prominent concern was the excessive number of students per class, which was rated at a high level ($\bar{x}$ = 4.02, SD = 0.71). Large class sizes may impede personalized instruction and reduce opportunities for active engagement in learning activities. Additionally, the outdated laboratory facilities were rated at a moderate level ($\bar{x}$ = 3.91, SD = 0.81). These facilities were perceived as insufficient to support the use of modern technologies necessary for inquiry-based learning and digital experimentation. Moreover, the physical layout of the classroom was considered unsupportive of collaborative or group-based learning methods, also receiving a moderate rating ($\bar{x}$ = 3.83, SD = 0.76). This suggests that current classroom configurations may not be conducive to interactive, student-centered instructional strategies.

Course content, learners, and instructors

In the area of course content, student perceptions were rated at a high level overall ($\bar{x}$ = 4.46, SD = 0.67). However, further analysis of subcomponents revealed several key issues. The highest concern was the misalignment between the actual course content and the course description ($\bar{x}$ = 4.49, SD= 0.70). In addition, students noted that there was no integration of newly updated content into the course ($\bar{x}$ = 4.46, SD = 0.66), reflecting a lack of curriculum renewal. Furthermore, the examples and case studies used in the course were reported to be limited in variety ($\bar{x}$ = 4.43, SD = 0.66), indicating a need for more diverse instructional materials.

In the area of learners, perceptions were also at a high level ($\bar{x}$ = 4.29, SD = 0.75). Among the subcomponents, the most prominent issue was a lack of motivation among students to attend the Digital Photography Technology course ($\bar{x}$ = 4.51, SD = 0.73). This was followed by students reporting insufficient foundational knowledge ($\bar{x}$ = 4.50, SD = 0.66), and a lack of structured thinking processes in solving problems ($\bar{x}$ = 4.38, SD = 0.69). These findings suggest that cognitive and affective readiness among students may be a barrier to effective learning.

Regarding instructors, the overall perception was again at a high level ($\bar{x}$ = 4.11, SD = 0.78). However, several issues were identified. The most critical thing was that instructors provided limited opportunities for students to ask questions during class sessions ($\bar{x}$ = 4.46, SD = 0.66). Moreover, instructors were perceived to hold negative attitudes toward students who were not well-prepared ($\bar{x}$= 4.11, SD = 0.91), and to lack strategies for motivating learners ($\bar{x}$ = 4.05, SD = 0.88).

Collectively, these findings highlight the need for pedagogical reforms that promote curriculum relevance, student engagement, foundational knowledge development, and inclusive teaching attitudes. Addressing these issues is essential for creating a more responsive and effective instructional environment, particularly in practice-based courses such as digital photography.

3. Learning behavior data of undergraduate students in the Digital Photography Technology course

An analysis of student learning behaviors in the Digital Photography Technology course revealed that the overall level of learning behavior among undergraduate students was rated high ($\bar{X}$ = 4.43, SD = 0.69). When categorized by specific domains, pre-class preparation, critical thinking and problem solving, and collaboration, the findings as shown in Table 3 are as follows:

Pre-class preparation

Students demonstrated a high level of readiness before attending class ($\bar{x}$ = 4.47, SD = 0.66). Within this domain, the highest-rated subcomponent was that students set clear goals to succeed in the course ($\bar{x}$ = 4.73, SD = 0.49), followed by their engagement in pre-lesson study prior to class sessions ($\bar{x}$ = 4.20, SD = 0.89), both rated at a high level.

Critical thinking and problem-solving

This domain was also rated highly ($\bar{x}$ = 4.44, SD = 0.72). Specifically, students reported a strong ability to summarize the process of problem analysis ($\bar{x}$ = 4.77, SD = 0.52), to synthesize knowledge or principles from multiple examples ($\bar{x}$ = 4.69, SD = 0.56), and to formulate guiding questions or issues to address problems ($\bar{x}$ = 4.64, SD = 0.65). Each subcomponent was rated at the highest level, indicating strong engagement with analytical and reflective thinking.

Collaboration

Student behavior in collaborative learning was also rated at a high level ($\bar{x}$ = 4.39, SD = 0.69). Subcomponent analysis showed that students actively participated in classroom activities ($\bar{x}$ = 4.76, SD = 0.43), respected differing viewpoints during group work ($\bar{x}$ = 4.69, SD = 0.59), and were able to respond to questions or explain concepts to peers who experienced difficulties ($\bar{x}$ = 4.66, SD = 0.52). All subcomponents were rated at the highest level, highlighting strong interpersonal engagement and peer support.

Table 3: Student learning behaviors in the Digital Photography Technology course

Learning behaviors in the Digital Photography Technology course	$\bar{x}$	SD	Level of behavior
Preparation before class			
1. Learners set goals to achieve success in their studies	4.73	0.49	Very high
2. Learners review lessons in advance before attending class.	4.20	0.89	High
Total	**4.47**	**0.66**	**High**
Critical thinking and problem-solving			
3. Learners are able to synthesize knowledge or principles from multiple examples	4.69	0.56	Very high
4. Learners can apply knowledge or principles to solve specific problems	4.11	0.91	High
5. Learners can clearly elaborate on their conclusions	4.60	0.62	Very high
6. Learners can evaluate and analyze the given problems	4.50	0.70	High
7. Learners can summarize the process of problem analysis	4.77	0.52	Very high
8. Learners can summarize the process of problem analysis	4.11	0.91	High
9. Learners are able to identify key issues as a basis for problem-solving	4.64	0.65	Very high
10. Learners can connect information and conclusions to the problems encountered	4.11	0.91	High
Total	4.44	0.72	**High**
Collaboration			
11. Learners actively participate in classroom activities.	4.76	0.43	Very high
12. Learners engage in extracurricular learning activities.	4.11	0.91	High
13. Learners accept differing opinions during group work	4.69	0.59	Very high
14. Learners seek clarification from peers who are more knowledgeable	4.05	0.79	High
15. Learners are able to answer questions or explain lesson content to peers with uncertainties	4.66	0.52	Very high
16. Learners exchange knowledge with peers outside the classroom	4.02	0.81	High
17. Learners take responsibility for their assigned tasks in group work	4.49	0.73	High
18. Learners share responsibility for the tasks assigned within the group	4.35	0.78	High
Total	4.39	0.69	**High**
In total	4.43	0.69	**High**

These results suggest that students in the Digital Photography Technology course exhibit a well-rounded set of learning behaviors, particularly in the areas of goal setting, critical thinking, and teamwork. Such behaviors are essential for developing higher-order cognitive skills and for fostering active, student-centered learning in applied disciplines. To address these challenges, the study proposes a development model, shown as Figure 4, which

integrates in-class activities centered on creation and understanding with out-of-class resources and interactive opportunities. This model incorporates feedback loops grounded in the IPO framework and applies Paul and Elder's elements of thought to deepen cognitive engagement. When implemented within a strategically designed instructional system, such as a technology-enhanced flipped classroom, this approach fosters creativity, enhances learner engagement, and facilitates effective knowledge transfer, aligning with findings from the researches by Bergmann and Sams, (2012, pp. 35-50) and Tucker (2020, pp. 7-8).

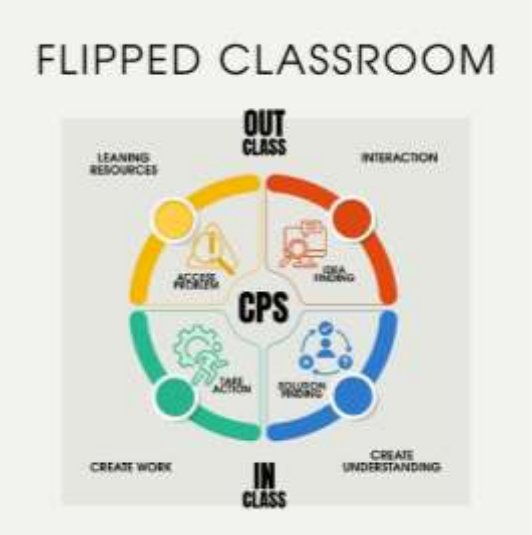

Figure 4: Model development

V. CONCLUSION AND DISCUSSION

In conclusion, the findings from Phase 1 of the study revealed key instructional challenges that influenced the development of a flipped classroom model designed to foster creative problem-solving among undergraduate students. These findings are organized into three major dimensions based on the Input-Process-Output (IPO) framework: First, input factors consist of course content, students, instructors, learning environment, and process factor. Although instructors employed a variety of instructional materials, the content was often overloaded and not effectively applicable across all topics. Moreover, examples drawn from instructors' personal experiences were found to lack relevance to students' contexts. According to Bergmann and Sams (2012, pp. 35-50). The use of technology such as instructional videos can help students grasp content better and allow for continuous refinement based on learner feedback. Students were found to possess a moderate level of foundational knowledge in photography concepts and principles; however, they lacked learning readiness, responsibility, analytical thinking, creativity, collaboration, and confidence in expressing ideas. Most instructors relied on lectures and case examples, with limited implementation of diverse hands-on activities. This limitation was partly attributed to large class sizes and the need to cover a wide range of content. The classroom setting, which typically consisted of approximately 80 students per session, contributed to a unidirectional (lecture-based) instructional format. The physical layout restricted instructors' ability to move freely and monitor student work effectively during in-class activities. Instructional practices in the classroom were primarily lecture-based, focusing on examples and instructor narratives in order to cover planned content. Although some instructors attempted to integrate group activities, student participation was limited due to a lack of confidence in sharing opinions. Out-of-class

learning was often structured around group projects, with students self-organizing into teams and working primarily at the end of sessions. Time constraints limited the opportunity for consultation and guidance, which hindered the effectiveness of core project components such as system design and testing. Chan et al. (2015, pp. 96-106) emphasized the value of smartphones in promoting student expression, peer interaction, and the pursuit of new knowledge through social and academic motivation. Similarly, Chuang (2017, pp. 688-693) found that smartphones can facilitate high-level collaborative learning when used effectively. Second, output factors include assessment and evaluation and Learning Outcomes. Assessment practices followed the lesson plan and included quizzes, midterm and final exams, and attendance records, using a norm-referenced grading system. Group projects were graded solely on final presentations, with no use of rubric. This approach limits the ability to evaluate students' practical competencies. Although the average student's performance appeared acceptable, critical skill gaps remained-particularly in system design, problem analysis, creativity, and teamwork. Panadero and Jonsson (2013, pp. 129-144) highlighted that using rubrics for formative assessment can reduce learner anxiety, provide clearer feedback, and enhance self-improvement and transparency in evaluation processes, thereby better supporting student performance in applied contexts. In phase 2, the analysis revealed that instructional design lacked a variety of examples or case studies and failed to incorporate updated content relevant to contemporary contexts. This shortcoming may be attributed to lecture-based teaching methods in large classroom settings, where instruction primarily relies on textbooks and instructors' personal experiences. According to Chang and Yu (2015, pp. 38-43), a learning environment that fosters creativity is positively correlated with innovative performance. Therefore, creating instructional settings that promote students' creative expression is essential. Students demonstrated low motivation and limited communication skills, particularly in out-of-class activities such as those in software engineering courses. This reflects a deficiency in essential 21st-century digital competencies. Organizations like ISTE (2016, online) emphasize the use of information and communication technologies (ICT) to support innovation and collaboration. Similarly, Phuapan et al. (2015, pp. 24-31) advocate for the integration of ICT to enhance learning, communication, and cooperation in higher education environments. Instructors were reported to provide insufficient motivation during lessons and limited opportunities for student questioning. Dick and Carey (2015, pp. 218-243) highlighted the significance of motivation using, Keller (1987, pp. 2-10) ARCS model, which comprises Attention, Relevance, Confidence, and Satisfaction all essential elements in enhancing learning performance. The instructional activities in class were neither diverse nor sufficiently effective in promoting analytical thinking or problem-solving skills. Bergmann and Sams (2012, pp. 35-50) proposed the flipped classroom model to stimulate students through inquiry-based learning and project work. Likewise, Flaherty and Phillips (2015, pp. 85-95) found that flipped learning promotes deeper learning, critical thinking, and sustained student engagement. The evaluation process relied heavily on final examinations, with limited use of formative assessment. Morrison et al. (2001, pp. 79-83) recommend learner analysis as a prerequisite to understanding prior knowledge. Gerlach and Ely (1980, pp. 200-238) also emphasized the importance of assessing entering behaviors as a foundation for designing effective instructional interventions. Large class sizes were found to inhibit group-based learning. Gerlach and Ely (1980, pp. 200-238) suggested that learner grouping should be determined by objectives, content, and learning methods. Giannakos et al. (2016, pp. 978-988) recommended the use of video-based learning ecosystems to support active learning in large cohorts, providing effective knowledge transmission and participation. Students demonstrated low levels of pre-class study behavior. Bergmann and Sams (2012, pp. 35-50) emphasized that preparation prior to class enhances content understanding through review, inquiry, and practice. Yousef et al. (2014, pp. 9-20) further noted that technologies such as MOOCs and

educational videos can effectively support both formal and informal learning. Students struggled to apply knowledge in real-life contexts, limiting the development of innovation-related skills. Chang et al. (2014, pp. 107-123) found that environments supporting creativity positively influence innovation performance. Additionally, cloud-based mobile learning (m-learning) was identified as a motivational tool that can enhance creative thinking. Students were unable to clearly elaborate or extend their conclusions. Kong (2014, pp. 160-173), in his study on digital classroom learning, found that well-designed instruction enhances information literacy and deep critical thinking in students. Students showed reluctance to communicate or ask questions, which impeded their teamwork capabilities. Liao et al. (2015, pp. 105-122) discovered that social networking platforms can foster enjoyment, engagement, and positive learner attitudes. These tools also promote collaborative learning and long-term motivation to participate actively.

In discussion, after reviewing the research, students demonstrated high levels of learning behaviors across all domains. Pre-class preparation had the highest mean ($\bar{x}$ = 4.47, SD = 0.66), indicating strong responsibility and readiness. Critical thinking and problem solving ($\bar{x}$ = 4.44, SD = 0.72) showed their ability to analyze and address issues effectively. Collaboration ($\bar{x}$ = 4.39, SD = 0.69) reflected good teamwork and communication skills. Overall, the results suggest students are well-equipped with key 21st-century learning skills. The study revealed several significant constraints within the instructional environment, particularly in the input and process dimensions as framed by the Input-Process-Output (IPO) model. These constraints include overloaded course content, lecture-centric teaching methods, large class sizes, and outdated laboratory facilities, consistent with observations by (UNESCO, 2015, pp. 113-114). Although the IPO framework emphasizes active reasoning and student engagement, instructors faced limited time for meaningful dialogic interaction. This structural limitation negatively impacted the development of students' problem-solving skills, as also noted by Mulder (2017, pp. 739-742). From the students' perspective, creative problem-solving abilities were rated highly ($\bar{x}$ = 4.44), suggesting a strong self-perceived competence. However, notable deficiencies were identified in terms of instructional variety and misalignment between assessment practices and intended learning outcomes. These discrepancies reflect a divergence from the intellectual standards of clarity, logic, and significance outlined by Paul and Elder (2006, pp. 19-22).

REFERENCES

Bergmann, J., & Sams, A. (2012). Flip your classroom: Reach every student in every class every day. International Society for Technology in Education.

Chan, N. N., Walker, C., & Gleaves, A. (2015). An exploration of students' lived experiences of using smartphones in diverse learning contexts using a hermeneutic phenomenological approach. *Computers & Education*, *82*, 96-106.

Chang, J. J., Hung, K. P., & Lin, M. J. J. (2014). Knowledge creation and new product performance: The role of creativity. *R&D Management*, *44*(2), 107-123.

Chang, Y. S., & Yu, K. C. (2015). The relationship between perceptions of an innovative environment and creative performance in an online synchronous environment. *Computers in Human Behavior, 49*, 38-43.

Chuang, Y. T. (2017). Leveraging mobile technology to facilitate students' learning engagement. *International Journal of Information and Education Technology*, 7(9), 688-693.

Dick, W., Carey, L., & Carey, J. O. (2015). The systematic design of instruction (8th ed.). Pearson Education. 218-243.

Flaherty, O, J., & Phillips, C. (2015). The use of flipped classrooms in higher education: A scoping review. *The Internet and Higher Education*, 25, 85-95.

Gerlach, V. S., & Ely, D. P. (1980). Teaching and media: A systematic approach (2nd ed.). Prentice Hall. 200-238.

Giannakos, M. N., Krogstie, J., & Aalberg, T. (2016). Exploring the video-based learning research: A review of the literature. *British Journal of Educational Technology*, *47*(4), 978-988.

International Society for Technology in Education (ISTE). (2016). ISTE standards for students. https://www.iste.org/standards/iste-standards-for-students.

Kahiigi, E. K., Hansson, H., Danielson, M., Tusubira, F. F., & Vesisenaho, M. (2011). Collaborative e-learning in a developing country: A university case study in Uganda. | In P. Kommers & P. Isaías (Eds.), *Proceedings of the 10th European Conference on e-Learning* (pp. 338-346). Academic Publishing Limited.

Keller, J. M. (1987). Development and use of the ARCS model of instructional design. *Journal of Instructional Development*, *10*(3), 2-10.

Kemp, J. E., Morrison, G. R., Ross, S. M., & Kalman, H. K. (2011). Designing effective instruction (7th ed.). Wiley. 136-155.

Kong, S. C. (2014). Developing information literacy and critical thinking skills through domain knowledge learning in digital classrooms: An experience of practicing flipped classroom strategy. *Computers & Education*, 78, 160-173.

Liao, Y. W., To, P. L., & Liu, C. C. (2015). The impact of the personal innovativeness, perceived usefulness and perceived ease of use on behavioral intention: The case of social network services in Taiwan. *Journal of Electronic Commerce Research, 16*(2), 05-122.

Morrison, G. R., Ross, S. M., Kemp, J. E., & Kalman, H. K. (2001). *Designing effective instruction* (4th ed.), 79-83.

Mulder, M. (2017). Competence theory and research: A synthesis. In M. Mulder (Ed.), Competence-based vocational and professional education (pp. 739-764). Springer. https://doi.org/10.1007/978-3-319-41713- 4_38

Panadero, E., & Jonsson, A. (2013). The use of scoring rubrics for formative assessment purposes revisited: A review. *Educational Research Review*, 9, 129-144.

Paul, R., & Elder, L. (2006). The miniature guide to critical thinking: Concepts and tools (4th ed.). Foundation for Critical Thinking. 19-22.

Phuapan, P., Viriyavejakul, C., & Pimdee, P. (2015). An analysis of digital literacy skills among Thai university seniors. *International Journal of Emerging Technologies in Learning (iJET)*, 10(3), 24-31.

UNESCO. (2015). Rethinking education: Towards a global common good? UNESCO Publishing. https://unesdoc.unesco.org/ark:/48223/pf0000232555.

Tucker, C. (2020). Balance with blended learning: Partner with your students to reimagine learning and reclaim your life. *Corwin,* 7-8.

World Economic Forum. (2024). Future of jobs report 2024. https://www.weforum.org/reports/the-future-of- jobs-report-2024.

Yamane, T. (1973). Statistics: An introductory analysis (3rd ed.). *Harper & Row*. 368-391.

Yousef, A. M. F., Chatti, M. A., Schroeder, U., Wosnitza, M., & Jakobs, H. (2014). MOOCs A review of the state of the art. In *Proceedings of the 6th International Conference on Computer Supported Education (CSEDU 2014)* (Vol. 1, pp. 9-20).