Online-Journals.org

iJEP International Journal of Engineering Pedagogy

iJEP | eISSN: 2192-4880 | Vol. 15 No. 5 (2025) | OPEN ACCESS

https://doi.org/10.3991/ijep.v15i5.53663

PAPER

The Application of Problem-Based Learning in Soft Skills Courses: An Experiment in Classes with Multidisciplinary Students in Vietnam

Thi Van Dang, Phung Tran Gia Bao, Vu Dinh Minh, Nguyen Thi Thanh Tu(✉)

Faculty of Education, Hanoi University of Science and Technology, Hanoi, Vietnam

tu.nguyenthithanh@hust.edu.vn

ABSTRACT

Soft skills are essential if graduates are to meet the demands of the 21st-century workforce. This represents a major challenge for higher education programs, which need to adopt teaching methods that effectively equip students with these essential skills. This study evaluates the impact of a problem-based learning approach to curriculum design on soft skills for multidisciplinary students. The elective course, which attracts a diverse cohort of students, is delivered in a blended learning format. Using a mixed-methods research approach, the study collected data via questionnaires from 140 multidisciplinary students split between experimental and control groups, supplemented by in-depth interviews conducted after the course. This paper describes a proposed teaching process based on problem-based learning and details the implementation of an experimental lesson on time management as part of the soft skills curriculum. The results indicate that problem-based learning not only enhances the development of soft skills but also encourages student initiative and creativity by improving individual and teamwork skills in both online and face-to-face learning environments. Based on these findings, the study recommends further research to broaden the application of problem-based learning in higher education contexts.

KEYWORDS

multidisciplinary students, problem-based learning, soft skills, time management

1 INTRODUCTION

Soft skills are an essential component of lifelong learning and are often more highly valued than technical expertise [1]. The term "soft skills" is also known as "essential skills" in New Zealand, "core skills" or "employability skills" in Australia, and "key skills" in the United Kingdom (UK). It frequently appears in reports on workforce skills in the modern labor market. According to the World

Dang, T.V., Gia Bao, P.T., Minh, V.D., Thanh Tu, N.T. (2025). The Application of Problem-Based Learning in Soft Skills Courses: An Experiment in Classes with Multidisciplinary Students in Vietnam. *International Journal of Engineering Pedagogy (iJEP)*, 15(5), pp. 20–41. https://doi.org/10.3991/ijep.v15i5.53663

Article submitted 2024-12-14. Revision uploaded 2025-05-07. Final acceptance 2025-05-07.

Economic Forum 2023, 82% of employers prioritize employee microcredentials when assessing their workforce [2]. In today's competitive job market, students cannot rely solely on their technical knowledge and skills to be competitive. Instead, they must adapt by developing non-technical skills that complement their traditional technical abilities [3]. Soft skills are essential in all professions, as they encompass a range of specific abilities that correspond to the occupational characteristics of each field. While technical skills enable learners to acquire the knowledge and skills needed to use tools or techniques in specific professional tasks [4], soft skills enable individuals to connect, collaborate, adapt, and lead effectively [5]. Therefore, to get a good job and achieve sustainable growth in any field, students need to equip themselves with soft skills to adapt quickly to the working environment, which underlines the importance of these skills in the educational process.

At Hanoi University of Science and Technology (HUST), teaching soft skills poses significant challenges due to the multidisciplinary composition of classes. Students from diverse academic backgrounds enter the university with varying levels of exposure to soft skills, creating a complex educational environment. Designing teaching methods that take account of this diversity is inherently difficult. The development of blended learning environments at HUST has steadily increased, fostering a culture that combines face-to-face and online learning. This approach has had a positive influence on student acceptance and engagement at HUST [6], optimizing the individual learning process while supporting self-study and distance learning. However, it also presents challenges for trainers, particularly in terms of designing training activities that extend learning beyond the confines of online platforms.

This study aims to implement and evaluate the application of the problem-based learning (PBL) approach in the design of teaching activities for soft skills courses at HUST. The specific objectives are as follows:

- Comparing the impact of the PBL approach with existing teaching methods on students' development of soft skills.
- Evaluating the effects of PBL on teamwork and collaboration skills among multidisciplinary students.
- Assessing the role of educational technology in supporting PBL during the soft skills training process for students.

This document is structured around the following three research questions (RQs):

- RQ1. How does PBL influence the teaching of soft skills to students compared to the current teaching methods?
- RQ2. How does PBL impact the teamwork and collaboration skills of multidisciplinary students?
- RQ3. How does educational technology apply to PBL support student training in the soft skills course?

The remainder of this paper is organized as follows. Section 2 presents a comprehensive review of the literature, highlighting the originality of the proposed work. Section 3 describes the methodological aspects of this research. The main results obtained are presented in Section 4 and discussed in Section 5. Finally, Section 6 presents the main conclusions of this study.

2 RELATED WORK

Soft skills, often referred to as social skills, have been defined from various perspectives by researchers. From some viewpoints, soft skills are non-specialized abilities encompassing interpersonal communication (e.g., communication skills) and self-management (e.g., internal skills), which can enable individuals to maximize work performance, display grace in communication, fluency in language, personal habits, friendliness, and optimism to varying degrees [7]. From another perspective, M. Martínez Ávila defines soft skills as personal attributes that facilitate effective and harmonious relationships with others, encompassing effective communication, teamwork, problem-solving, and leadership [8]. *Thus, soft skills refer to a combination of abilities and personal qualities that are not directly related to specialized knowledge but often influence how individuals interact, work, and communicate in both life and work.* The basic soft skills considered essential for students [9] include communication skills, critical thinking and problem-solving skills, teamwork skills, lifelong learning and information management skills, entrepreneurial skills, ethics and professional ethics, and leadership skills. In higher education, equipping students with soft skills is increasingly critical, as graduates must face modern workforce demands such as career readiness, effective communication, holistic development, improved employability, academic success, adaptability to change, building professional relationships, and workplace efficiency [10]. The studies mentioned above highlight the multifaceted nature of soft skills and their critical role in higher education. As the demand for these skills continues to rise, educational institutions are increasingly integrating soft skills training into their curricula to better prepare students for the professional world. Understanding and developing these skills is essential for personal growth, academic success, and career readiness, making soft skills a fundamental component of holistic education.

To enhance soft skills development, educational institutions frequently organize capacity-building programs for their students. Currently, common strategies and active learning methods for teaching soft skills include project-oriented PBL [11], [12]; case-based learning [13]; experiential learning [14]; collaborative learning [15]; game-based learning [16]; blended-learning [17]; project-based learning [18], PBL [19]. These methods underscore the significance of integrating soft skills training into higher education curricula to prepare students for the demands of the modern workforce. Among these strategies, PBL is regarded as the most effective approach for fostering soft skills. For example, at McMaster University, PBL is highly valued for its key features, including open-ended and challenging problems, collaborative group work, and instructors acting as facilitators to encourage inquiry and curiosity [22, 23]. PBL narrows the gap between education and real-world applications by equipping learners with essential tools and skills, including the application of technology for data collection and problem-solving.

Problem-based learning originates from experiential learning theory, which helps bridge the gap between education and real-world employment. PBL was first implemented in medical education in Canada in 1969; it is a learner-centered approach that stimulates learning through real-world problems [20]. PBL can be applied to individuals and groups in a classroom or any type of training program and has been continuously evaluated for its effectiveness in various fields of education. Recent studies show that 89.6% of medical students develop teamwork, communication, and independent thinking skills through PBL [21]. Similarly, education students report that frequent discussions enhance the process of improving soft skills [22]. Language students have recognized the superior effectiveness of PBL in developing teamwork, time management, critical thinking, and problem-solving

skills [23]. Furthermore, PBL helps enhance creativity and logical thinking, interpersonal behavior, and professional ethics among social science students [5]. In recent studies on technical students, Tadjer et al. found that computer engineering students recognize the importance of soft skills in solving problems while learning hard skills [24], and computer science students significantly develop time management skills, confirming that PBL is effective in improving work performance [25]. Additionally, PBL helps chemical engineering students expand their critical thinking, interdisciplinary entrepreneurial spirit, and develop active teamwork skills [8].

Based on years of research, the research team found that PBL is widely applied in STEM fields across various countries. The focus is on developing soft skills through the hard skills of a particular profession. In other words, most instructors apply PBL in a specific subject, where students solve subject-related problems, and group activities are incorporated alongside the development of soft skills in the learners. It can be seen that the primary goal remains the development of hard skills, and there is a lack of in-depth research on soft skills training–skills the authors refer to as basic skills: communication, presentation, teamwork, time management, etc. These skills form the foundation for the development of more complex skill sets that support students in successfully performing future tasks. Therefore, this paper focuses on the independent teaching method for soft skills, emphasizing the design of learning activities for students to practice and refine their skills. Recognizing many advantages of PBL in skill development, the authors have chosen to integrate PBL into the design of the soft skills curriculum using a blended learning approach, which HUST encourages to enhance the quality of teaching.

At HUST, soft skills is an elective course for students who are interested. Students enrolling in the course come from various STEM majors such as electrical engineering, electronics, information technology, mechanical engineering, chemistry, physics, etc., with diverse ages. This diversity presents a challenge for instructors in designing course content that aligns with the varying levels of understanding and skills of multidisciplinary students. Teaching soft skills in a multidisciplinary environment presents specific challenges, including diverse academic backgrounds, varying skill levels and large class sizes, as well as participation and interaction, assessment and evaluation, and resource limitations [26], [27]. The demand for support with asynchronous online learning activities among engineering students has increased following the COVID-19 pandemic. This presents an opportunity for students to significantly develop their technology skills for engaging in online classes [28]. Learning management systems (LMS) play a crucial role in connecting learning tasks with open educational resources, fostering self-directed learning among engineering students. This provides students with access to diverse knowledge and facilitates the organization of learning activities and interactions for both students and instructors [29]. Currently, HUST is teaching the soft skills course using a flipped classroom model. Students learn theoretical knowledge through tracking lectures on the LMS, reflecting on the content, and completing quizzes. Subsequently, they apply the knowledge and experience gained to practical exercises during in-person sessions. The current implementation of the teaching process has identified issues with asynchronous lessons, which are considered inefficient and do not fully leverage the strengths of technology in supporting learners. Additionally, the low level of student interaction on the system results in a waste of learning resources [30]. The question raised by the research team is, how can learners become more proactive and learn to apply knowledge to real-life situations? This question underscores the necessity for reforming teaching methods. PBL is the approach that the team aims to explore deeply and apply in the design of learning activities on the LMS to better support learners in developing a deeper understanding and practicing skills through the enhanced support of educational technology.

3 MATERIALS AND METHODS

3.1 Research design

The soft skills course focuses on developing basic personal skills that connect with collaborative personal skills for students. PBL is an extremely effective training method for learners in the process of problem-solving. Based on the key objectives of the course, the authors proposed the following steps in the process of organizing soft skills teaching using PBL with a blended-learning format (see Figure 1).

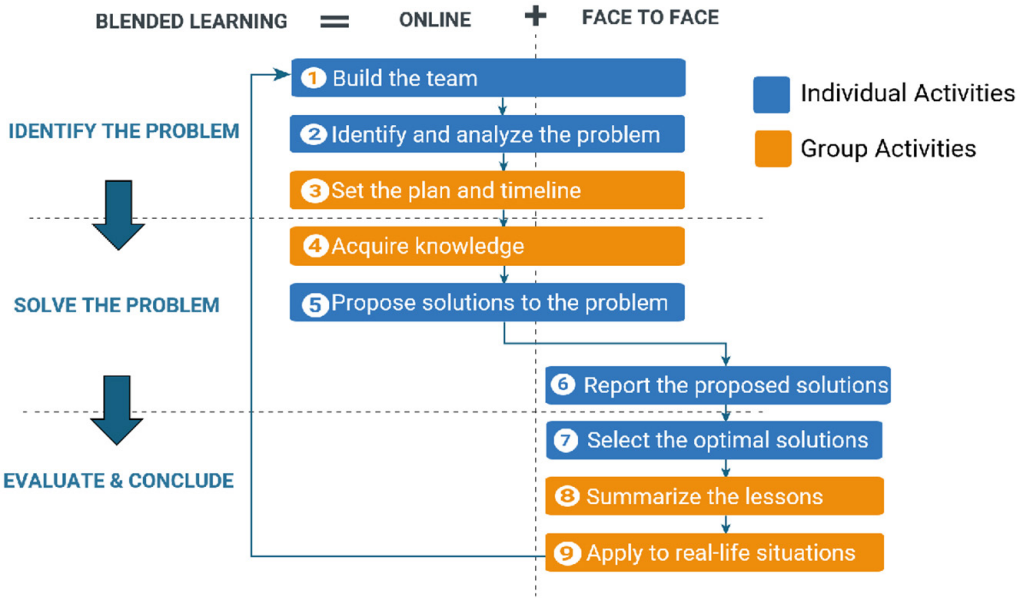


Fig. 1. Proposed PBL teaching process for the soft skills course

Step 1: Identify the problem: The essential requirement in the first step is to design problem scenarios that create a high degree of conflict between what is known and what is unknown, stimulating the need for learning in order to find out solutions to resolve these conflicts. The proposed process for implementation is shown in Table 1.

Table 1. Description of the problem identification process

Process	Learner Activities	Skill Practice
1. Build the team	• Identify the personality of each team member. • Assign roles: team leader, secretary, etc. • Set up an online workspace.	• Communication skills • Team bonding skills • Leadership and social connection skills
2. Identify and analyze the problem	• Analyze the problem assigned to the team. • Present the evaluation criteria for the group assignment.	• Analytical and innovative thinking skills • Critical thinking and analysis skills • Collaboration skills
3. Set the plan and timeline	• Create a plan and delegate tasks to team members. • Develop a task execution plan on the LMS tracking board.	• Planning skills • Technology usage, monitoring, and control skills

Step 2: Solve the problem: In this step, learners need to acquire additional knowledge about the problem as identified in Step 1. Designing individual learning tasks is an important step for learners to practice micro-skills and reinforce the knowledge provided in the instructional materials. Here, the authors proposed two key practical activities for learners (refer to Table 2), including *Learning Tasks:* When solving the task, there is a predefined sequence, along with the necessary knowledge and skills to resolve it; *Learning Problems:* These will be addressed through problem-solving strategies such as trial and error, restructuring, systematical thinking, and creativity.

Table 2. Description of the problem-solving process

Process	Learner Activities	Skill Practice
4. Acquire knowledge	• Learn course content via LMS: videos, materials • Do interactive exercises to reinforce knowledge • Apply the learning tasks to real-life situations of students	• Information search and management skills from diverse learning sources • Time management skills • Active learning skills and strategy development
5. Propose solutions to the problem	• Apply knowledge to solve specific group problems	• Creative and proactive thinking • Problem-solving skills for complex issues • Collaboration and coordination skills • Positive empathy and active listening skills
6. Report the proposed solutions	• Present and defend the group's solutions. • Develop communication and presentation skills for students.	• Communication and presentation skills • Skills in selecting and using technology through product design

Step 3: Evaluate and conclude: Evaluate the accuracy and real-world relevance of the solution; assess the feasibility or optimality of the solution; systematize knowledge, explore potential applications of the results, and adjust individual activities accordingly (refer to Table 3).

Table 3. Description of the evaluation and conclusion process

Process	Learner Activities	Skill Practice
7. Select the optimal solution	• Create a discussion session to reverse the problem-solving approach of each group. • Evaluate the practicality and optimality of the solutions.	• Critical thinking and analysis skills • Positive empathy and active listening skills • Persuasion skills
8. Summarize the lessons learned	• Provide feedback to improve the product and assess its level of completion. • Systematize knowledge.	• Persuasion and negotiation skills • Self-regulation and self-learning skills
9. Apply to real-life situations	• Explore the potential applications of the results to different situations. • Propose new problems and encourage students to practice on their own. • Provide detailed feedback on individual learning tasks via the LMS.	• Effective & flexible working skills

One of the aspects the authors focus on when proposing the integration of PBL with blended learning (B-learning) in the design of the soft skills course is that PBL allows learners to take control of their learning materials and acquire knowledge in any environment. This flexibility in learning is crucial for students in large classes,

such as the one with 100 multidisciplinary students. The authors emphasize the importance of designing learning activities that provide more personalized tracking and support for each student. Basic personal skills require learners to engage in self-study and practice through learning tasks on the LMS. Students have the flexibility to organize their own schedules and choose the most effective times for their learning. Furthermore, the LMS collects completed tasks from students and notifies instructors, enabling them to quickly address any issues that arise with individual students. This ensures that students receive timely support. Learning activities are tightly integrated between online and in-person formats. The combination of individual and group activities is key to the learning process. Group work, both online and offline, serves as a vital link. It allows students to apply the skills they have gained through self-study to complete tasks assigned by the group. Online group meetings are recorded, which helps instructors identify any issues that arise during the students' collaborative work. These observations are then compared with the students' behavior during their final product presentations in class. Whether students are learning online or in person, they always have opportunities to interact, exchange ideas, and practice the course content.

Based on the proposed PBL organization process, the authors suggest a research process to evaluate the effectiveness of PBL in enhancing the quality of teaching and learning the soft skills course at HUST (see Figure 2). The main focus is to investigate the learning and skill development process of the learners and the effectiveness of PBL in teaching the course. The research team randomly selected two soft skills classes after multidisciplinary students registered for the course schedule to conduct the experiment.

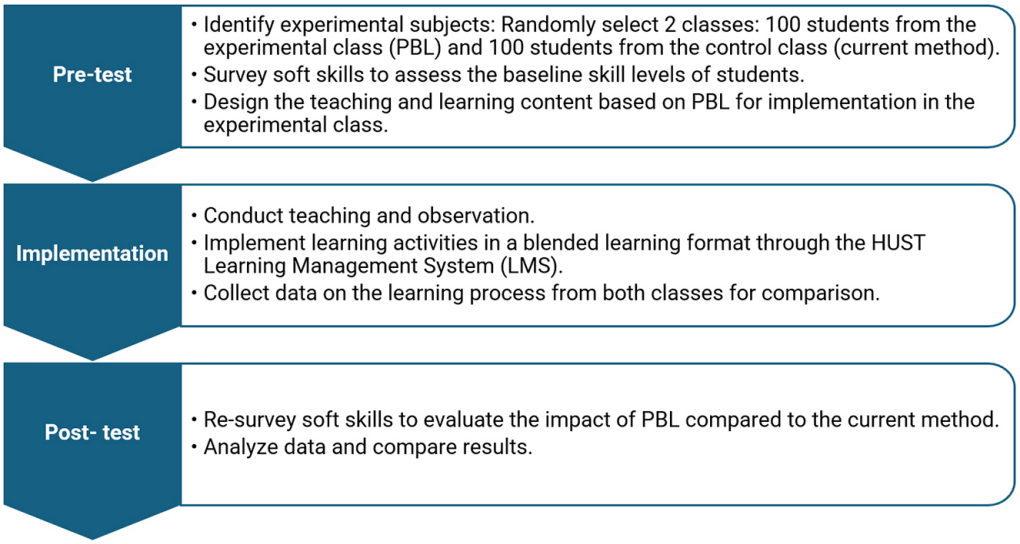


Fig. 2. Research modeling

Phase 1: Pre-test: The purpose of the pre-survey phase is to assess the students' particular skills before they engage in the course, ensuring input consistency between the experimental and control groups. Participation in this survey is voluntary, and the feedback is collected anonymously to ensure honesty and reduce bias in responses. The authors will use the input data collected to compare with the output results after the learners have participated in the research activity.

Phase 2: Implementation: The Soft Skills course is implemented and taught in a B-learning format for all students. Therefore, when conducting the experiment, the authors selected and designed teaching activities for the topic "Effective Time Management Skills" to collect data to answer three research questions, specifically:

RQ1: The authors designed an illustrative lesson based on PBL and conducted teaching in the experimental class. The control class studied the same lesson using the currently implemented method. Time management skill surveys, administered before and after the lessons in both classes, were used for analysis and comparison to answer this research question.

RQ2: The authors evaluated group activities and collaboration of students in the experimental class through two activities: the "Planning & Time Usage" activity using data collected from the LMS within the groups (work planning charts, group assignment progress, minutes from online group meetings via Microsoft Teams), and the "Product Reporting" activity collecting information from group product reports, in-class product presentations, and peer feedback sessions.

RQ3: During the experimental class's participation in the course, the authors designed individual learning tasks on the course LMS to collect learner behavior data from the system, such as the number of on-time submissions over the weeks, the number of completed quizzes, the number of interactions with group activities, and students' self-assessment scores. The authors combined this data with instructor evaluations, including peer assessment scores within groups, scores for learning tasks, and individual quiz scores, to compare correlations and clarify the role of educational technology in supporting instructors' tracking of student behavior throughout the course.

Phase 3: Post-test: After the course was completed, the authors collected data from the performance results of individual learning task completion (collected via the LMS), the group-based problem-solving project, monitoring learner interaction behavior on the LMS throughout the course, and a time management skills survey after participating in the PBL-based course. Those data are then analyzed and evaluated to assess the effectiveness of PBL in enhancing the quality of soft skills teaching at Hanoi University of Science and Technology.

3.2 Data collection

Survey form: The survey is created using Microsoft Forms to administer pre- and post-course surveys for 200 students from both the experimental and control groups, ensuring an easy-to-use interface and easy data management.

Group activity observation: Take notes on the students' activities during the experimental implementation.

In-depth interviews: Conduct indirect interviews after the course via email or voice messages to collect detailed responses regarding the research information.

Gathering of learning behavior data: The authors collected data from the HUST LMS, which stores students' learning behaviors over time: lecture tracking activities, assignment submissions, quiz results, comments, and interactions in group projects. All data are extracted into MS Excel for efficiency of coding and data processing.

After all the data are collected from the platforms, the authors process the primary data and import it into SPSS 22.0 for data analysis.

3.3 Design of the experimental content

The soft skills course is being taught over 45 class periods during the seven-week summer semester. The content and objectives of the course are fixed within the curriculum, consisting of two major skill groups: *basic personal skills and collaborative personal skills*.

The specific lessons include effective teamwork, time management, positive thinking and life values, effective communication, effective presentation, and the art of persuasion. The authors selected the lesson titled 'Effective Time Management' for this study from the soft skills course and conducted a survey using Microsoft Forms to collect data from 200 students enrolled in both the experimental and control soft skills classes.

First, the authors conducted an assessment of time management skills through a pre-course survey before students began the seven-week course. The authors compiled research on time management from various countries, spanning from 1988 to the present, including China, Taiwan, Portugal, Croatia, etc. [28], [32], [33], [34], [35]. Time management is generally defined as behaviors aimed at achieving efficient use of time when performing activities directed toward goals [36], while recognizing that time can be managed and actively using skills, strategies, and tools to create and maintain flexible habits, as well as the ability to evaluate personal effectiveness [37]. A series of measurement tools was developed by experimental researchers, with over 10 different scales designed to measure time management [36]. Among these, four scales are the most widely used today: Time structure questionnaire [38]; Time management questionnaire [39]; Time management behavior scale (TMBS) [40]; Assessment of time management skills [37]. The authors focused particularly on the structure of the TMBS scale due to its alignment with criteria for evaluating behaviors, attitudes, and emotions of students in time management. The TMBS, developed by Macan et al. (1994), discovered that time management can improve one's perception of time control, positively affecting work performance, job satisfaction, and reducing stress. TMBS is suitable for broadly evaluating time management skills and enhancing awareness of time control. Building upon and adapting it for technical students in the soft skills course, the authors designed a time management skills assessment tool that includes the following criteria: Planning, time use, and self-control of time, using a Likert scale with 5 levels: (1) Strongly Disagree; (2) Disagree; (3) Neutral; (4) Agree; (5) Strongly Agree.

Next, the authors designed the lesson plan and organized the classes for both the experimental and control groups, using the same lesson on "Effective Time Management." Students in the control group will follow the current teaching process: watching the lesson video on the LMS and completing quizzes on the system. In-class sessions will involve forming groups to practice the content of the lesson. Meanwhile, students in the experimental group will experience the lesson following the detailed PBL process outlined in Table 4.

Table 4. Lesson content on "Effective Time Management"

Learning Objectives
1. Be able to distinguish the four generations of time management and the advantages/disadvantages of each generation.
2. Understand the time management model and the significance of each component in the model.
3. Be able to create a plan based on identifying personal and work roles and objectives.

The authors designed a teaching and learning plan for the lesson "Effective Time Management" that spans 6 class periods in a blended learning format. Based on the analysis of the results of the initial survey assessing students' time management skills, the authors designed the teaching activities following a PBL approach as described in Table 5.

In the process outlined in Table 5, self-study activities, group formation, and group assignments are all implemented online. This approach provides students with the opportunity to independently arrange their personal schedules, adjust their time flexibly, and fully engage in the learning activities of the lesson. They can

choose the most effective study times that align with their individual learning pace. Over the course of the 7 weeks, time management skills will be continuously developed through the design and adherence to their personal schedules. However, tracking students' learning progress and managing personal planning can become challenging without technological support, which is essential for instructors to effectively monitor a large class of up to 100 students. When performing individual tasks online, all learning activities are supported and processed in a timely manner.

Table 5. Lesson plan for the experimental class

Format	Activity Objectives	Skills Developed by Students	Technology Tools Supporting Students
Online	**1.** Build the Team • Build a Multidimensional Team Based on DISC Classification • Create an Online Workspace	• Communication Skills • Relationship Building and Team Formation Skills	• DISC Personality Assessment System • Group List
	2. Identify & Analyze the Problem • Analyze the Situation to Present the Problem • Identify the Objective of the Problem	• Short-term and Long-term Goal Setting Skills • Skills for Identifying and Analyzing Complex Problems • Collaboration Skills	• Progress Report Files for Each Group via MS Excel • Evaluation Criteria Sheets with Different Levels
	3. Set the Plan and Timeline for Solving the Problem • Develop a Plan and Assign Tasks to Team Members • Independently Develop a Plan to Organize Individual Learning Processes	• Skills for Prioritizing Tasks • Personal Planning and Tracking Skills • Skills for Choosing Software to Monitor Work Progress	
	4. Acquire Knowledge • Learn About the Time Management Matrix, the 5A Management Model • Complete a Time Management Theory Test • Practice Individual Learning Tasks: Create a Weekly Personal Plan and Identify Time Thieves, Adjusting for the Following Week's Plan	• Skills for Flexibly Managing Time According to the Plan • Skills for Applying Technology to Notify Online Learning Schedules • Skills for Categorizing and Organizing Documents • Active Learning Skills for Applying Them Personally	• Electronic Learning Sheets Submitted on LMS • Self-Practice Questionnaires on LMS • Lecture Materials
	5. Propose Solutions to the Problem • Exchange Ideas and Develop a Roadmap for Problem Solving • Complete the Report	• Skills for Balancing Personal and Group Time • Skills for Setting Specific Deadlines for Group Tasks • Skills for Report Writing and Monitoring Progress via Software	• Group Progress Meeting Minutes • Group Product Report Collected for Learner Evaluation Data
Offline	**6.** Report the Proposed Solutions • Report the Group's Product	• Skills for Focusing on Work Without Distractions • Communication Skills • Technology Skills	
	7. Select the Optimal Solution • Participate in Adding and Asking Questions • Adjust Limitations in the Group's Product	• Persuasion Skills • Critical Thinking • Listening Skills	• Group Product Evaluation Sheets via MS Forms
	8. Summarize the Lessons Learned • Systematize Knowledge	• Self-assessment of Group and Individual Activities • Information Synthesis Skills	• Knowledge Systematization Diagram • Grading and Feedback Sheets for Individual Practice
	9. Apply to Real-Life Situations • Adjust and Improve the Personal Schedule for the Following Weeks	• Metacognition: Self-planning, Self-implementation, and Self-adjustment of Issues in Life	

In addition, to further clarify students' practice, the authors designed group activities that introduce real-life context issues from students' lives right from the group formation stage. This approach demonstrates the strong connection between self-developed personal skills and their application in group activities. The group activity, which combines both online and in-person formats, is more complex than individual tasks and requires skills in planning, setting priorities, and effectively managing the group's time. As a result, individuals encounter more challenges in this process. Moreover, this issue helps students apply the 5A time management model techniques, categorizing tasks according to urgency using the Eisenhower Matrix they learned in class, in order to balance both personal and group activities.

Online meetings provide an opportunity for multidisciplinary students to engage in discussions, given the differences in their academic schedules. Each meeting encourages students to participate more actively in group discussions, stay more focused, and collaboratively solve problems. On the other hand, videos and reports after each meeting help the instructor clearly identify any issues that arise when students work independently with each other, compared to the behavioral traits observed during their product presentations in class. By leveraging the advantages of B-learning, the authors designed a lesson plan closely following the PBL process to optimize the student experience and develop small skills to improve students' time management skills. Finally, after the experiment is implemented, the authors collected data from the post-course survey and conducted interviews to gather further insights from students' feedback.

4 MAIN RESULTS

4.1 RQ1: How does PBL influence the teaching of soft skills to students compared to the current teaching methods?

The authors conducted an analysis based on three criteria from the survey, comparing the correlation between each criterion for the experimental class (100 students) and the control class (100 students). After conducting the survey, incomplete or erroneous responses from the pre- and post-surveys were discarded to ensure the data was clean and reliable. The results collected from the survey will be cleaned and entered in the database. The authors analyzed the results from 84 students in the experimental class and 56 students in the control class (refer to Tables 6 and 7).

Table 6. Demographics of students in experimental and control groups

	Gender		Age				Year of Study		
	Male	Female	18	19	20	≥21	1–2	3–4	5
Experimental Class	80	4	14	32	30	8	74	9	1
Control Class	42	14	9	24	6	5	41	13	2

Table 7. Cronbach's alpha reliability coefficients for scales

Criteria	Reliability Coefficient for the Experimental Class			Reliability Coefficient for the Control Class		
	N	Pre Test	Post Test	N	Pre Test	Post Test
P1: Planning (11 Indicators)	84	0.831	0.819	56	0.918	0.862
P2: Time Management (8 Indicators)	84	0.740	0.778	56	0.820	0.819
P3: Self-control of Time (6 Indicators)	84	0.687	0.794	56	0.854	0.832

The Cronbach's alpha coefficient (refer to Table 7) is used to assess the internal consistency of the three aspects of time management skills, with all values exceeding 0.65, indicating that the reliability of the scales meets the required standards.

First, the authors compared the input correlation between the two classes using the T-test (refer to Table 8). This test is designed to examine the differences between the two independent groups, the experimental and control classes, based on each criterion in the time management skills scale.

Table 8. Comparison of pre-test between the two classes using the T-test

Independent Samples Test										
PreTest Experimental Class – Control Class		Levene's Test for Equality of Variances		T-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-Tailed)	Mean Difference	Std. Error Difference	Interval of the Difference	
									Lower	Upper
PreTest_P1	Equal variances assumed	.649	.422	–2.184	138.000	.031	–.265	.121	–.505	–.025
PreTest_P2	Equal variances assumed	.888	.348	–.905	138.000	.367	–.099	.109	–.315	.117
PreTest_P3	Equal variances assumed	2.350	.128	–.274	138.000	.785	–.033	.120	–.269	.204

The results in Table 8 show that

- PreTest_P1: There is a statistically significant difference between the average scores of the two classes (Sig. = 0.031 < 0.05). The average score of the control class (3.484) is higher than that of the experimental class (3.219), indicating the need for training interventions to improve P1 skills.
- PreTest_P2: There is no statistically significant difference between the average scores of the two classes (Sig. = 0.367 > 0.05). The average scores for the two classes are 3.332 and 3.431, respectively, suggesting a need for improvement in P2 skills.
- PreTest_P3: There is no statistically significant difference between the average scores of the two classes (Sig. = 0.785 > 0.05). The average scores for the two classes are 3.137 and 3.170, respectively, indicating the need for improvement in P3 skills.

This indicates that the two classes are equivalent in terms of their pre-test time management skills on criteria P2 and P3, while the control class has higher scores on some indicators for criterion P1.

Secondly, the authors compared the pre- and post-impacts of PBL on the experimental class and the pre- and post-impacts of the current teaching methods on the control class in order to evaluate the process of developing soft skills in students. This is based on the results of a T-test analysis from the post-course survey completed by students in both classes (refer to Tables 9 and 10).

Table 9. Results of the comparison between the two classes before and after the course

Paired Samples Statistics						Paired Samples Statistics					
Experimental Class		Mean	N	Std. Deviation	Std. Error Mean	Control Class		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	PostTest_P1	3.578	84	0.604	0.066	Pair 1	PostTest_P1	3.424	56	0.637	0.085
	PreTest_P1	3.219	84	0.665	0.073		PreTest_P1	3.484	56	0.759	0.101
Pair 2	PostTest_P2	3.558	84	0.611	0.067	Pair 2	PostTest_P2	4.496	56	0.615	0.082
	PreTest_P2	3.332	84	0.616	0.067		PreTest_P2	3.431	56	0.661	0.088
Pair 3	PostTest_P3	3.440	84	0.670	0.073	Pair 3	PostTest_P3	3.271	56	0.754	0.101
	PreTest_P3	3.137	84	0.647	0.071		PreTest_P3	3.170	56	0.757	0.101

Experimental Class		Paired Differences					t	df	Sig. (2-Tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	PostTest_P1- PreTest_P1	0.359	0.484	0.053	0.254	0.464	6.811	83	0.000
Pair 2	PostTest_P2-PreTest_P2	0.226	0.617	0.067	0.092	0.360	3.358	83	0.001
Pair 3	PostTest_P3-PreTest_P3	0.304	0.683	0.075	0.155	0.452	4.073	83	0.000

Control Class		Paired Differences					t	df	Sig. (2-Tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	PostTest_P1-PreTest_P1	–0.060	0.534	0.071	–0.203	0.083	–0.842	55	0.403
Pair 2	PostTest_P2-PreTest_P2	0.065	0.726	0.097	–0.130	0.259	0.667	55	0.507
Pair 3	PostTest_P3-PreTest_P3	0.101	0.772	0.103	–0.106	0.308	0.980	55	0.331

Table 10. Results of the comparison between the two groups after the end of the course

Independent Samples Test										
PostTest Experimental Class – Control Class		Levene's Test for Equality of Variances		T-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-Tailed)	Mean Difference	Std. Error Difference	Interval of the Difference	
									Lower	Upper
PreTest_P1	Equal variances assumed	.299	.585	1.448	138.000	.150	.154	.107	–.056	.365
PreTest_P2	Equal variances assumed	.073	.787	.591	138.000	.555	.063	.106	–.146	.271
PreTest_P3	Equal variances assumed	.077	.781	1.394	138.000	.165	.170	.122	–.071	.410

The analysis of the results in Tables 7, 9, and 10 enables us to compare the indicators for the two classes (refer to Table 11).

Table 11. Comparison of indicators for the two classes

	Experimental Class	Control Class
1. Paired Samples Statistics	**P1:** The average score increased, and this significant difference is statistically meaningful. This indicates a strong impact of the course on P1. **P2:** The average score increased, with a highly significant difference between the pre- and post-test scores, demonstrating a substantial improvement statistically. **P3:** The difference of 0.304 confirms that the course had a significant impact on this group.	**P1:** The average score slightly decreased, indicating no significant improvement after the course. **P2:** The average score increased, showing improvement, but the increase was not substantial. **P3:** The average score slightly increased, suggesting no clear change.
2. Paired Samples Correlations	**P1:** A strong correlation between the pre- and post-course scores, indicating a clear connection between the two scores. **P2:** A moderate correlation (r = 0.493), showing that the post-course score is influenced by the pre-course score. **P3:** A moderate correlation, but still significant enough to conclude that there is a relationship between the two stages.	**P1:** The correlation between the pre- and post-course scores is quite strong, indicating a close link between the two scores. **P2:** The correlation is weaker (r = 0.355), suggesting a medium level of relationship between the pre- and post-course scores. **P3:** The correlation is moderate, indicating a significant but not as strong relationship as in P1.
3. Paired Samples Test	**P1:** The difference between pre- and post-test is 0.359, indicating a statistically significant difference. **P2:** The increase is 0.226, also showing a significant statistical improvement. **P3:** The difference of 0.304 confirms that the course had a significant impact on this group.	**P1:** The difference between pre- and post-test is –0.060, which is not statistically significant, indicating no substantial improvement after the course. **P2:** The difference is 0.065, and this change is also not statistically significant. **P3:** The difference is 0.101, showing no statistically significant change before and after the course.
4. Conclusion	The correlation coefficients indicate a relationship between the pre- and post-course scores, with P1 showing the strongest correlation. The T-test results show that all differences are statistically significant (p-value < 0.05), proving that these improvements are not due to chance but are the result of the course's impact.	The T-tests showed no significant difference before and after, meaning the course had no substantial impact on the students' score changes. The correlation between the pre- and post-course scores shows some relationship, but it is not strong enough to prove that the course's impact is clear.

To conclude:

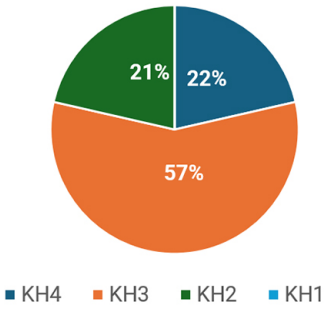
- Post-test_P1: Before the course, the control class had significantly higher scores than the experimental class, but after the course, the difference was no longer clear. This indicates that the experimental class made a substantial improvement in planning skills after the course, narrowing the gap with the control class.
- Post-test_P2: All indicators increased in both classes, with the experimental class showing a larger increase compared to the control class.
- Post-test_P3: All indicators increased in both classes, with the experimental class showing a larger increase compared to the control class.

Thus, the criteria for all groups showed improvement, and the application of PBL in the experimental class positively impacted students' progress in all three groups (P1, P2, P3), especially in group P1, which showed the most noticeable change. Meanwhile, the control class did not exhibit any significant improvement in the skills assessed in the control class. This confirms that the application of PBL had a positive effect on students' development, significantly improving their time management skills.

4.2 RQ2: How does PBL impact the teamwork and collaboration skills of multidisciplinary students?

To assess students' teamwork and collaboration abilities, the authors collected data from LMS based on two criteria: group activities for the major assignment and group product presentation activities for problem-solving.

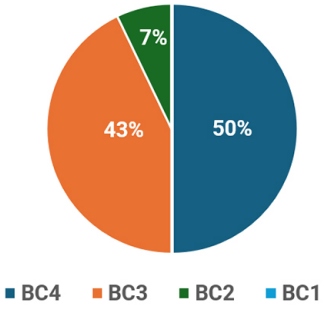
Firstly, teamwork and collaboration were evaluated through planning and time management: The authors collected data from LMS in the groups, including work plan tables, projected progress tables for group assignments with detailed timelines, and meeting minutes files summarizing information from online discussions. Based on this, the authors compared the actual meeting times of the groups with the projected schedules, leading to the classification and evaluation of 14 groups in the experimental class according to the levels shown in Figure 3.



SCORE		DESCRIPTION
KH4	3	Fully completed meeting minutes according to the initial projected schedule created by the group
KH3	2	40-60% of meeting minutes completed according to the initial projected schedule created by the group
KH2	1	10-30% of meeting minutes completed according to the initial projected schedule created by the group
KH1	0	Not submitted / Submitted an empty file

Fig. 3. Planning and time management results

Secondly, teamwork and collaboration were evaluated through the product report. The authors classified the groups into 4 levels (see Figure 4) based on the degree of applying the time management and task management knowledge learned, as presented in the course report. The report clearly showed the identification of the group's problem objectives, listing the tasks the group needed to complete, prioritizing the tasks, assigning tasks to group members according to a specific timeline with dates and times, and each meeting having videos and meeting minutes to track the progress of the product completion. This clearly demonstrates the effective application of time management skills in solving real-life problems, with the collaborative effort of multidisciplinary students working together.



ITEM	SCORE	DESCRIPTION
BC4	3	Fully completed product report
BC3	2	40-60% of the product report completed, missing some parts
BC2	1	10-30% of the product report completed, missing several parts (incomplete)
BC1	0	Not submitted / Submitted an empty file

Fig. 4. Product report results

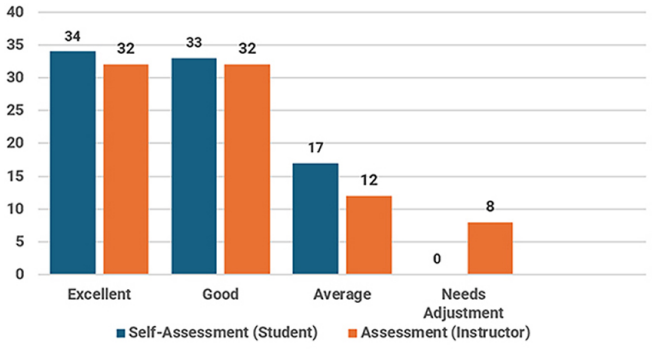
Instead of randomly assigning groups, the authors used the DISC personality assessment system to create groups of 7 students, each with a balanced mix of

personality types. This is because personality traits play an important role in leadership and team motivation [41] and directly affect team performance [42]. The 14 experimental groups were assigned tasks that aligned with the common interests of multidisciplinary students in developing skills, specifically student crises, job interviews, student romance, social ills, online behavior of young people, etc. The groups discussed issues on Microsoft Teams and were required to document their teamwork process through a report journal stored electronically. The authors then extracted data from the LMS, combined with random participation in group meetings, and found that the groups effectively applied time management skills in planning and solving the assigned problems. They also organized group meetings in detail, assigning tasks to make efficient use of time for collaborative learning. Students from various fields brought diverse perspectives to problem-solving, and during the observed meetings, efforts were made to reach a consensus. The meeting minutes recorded each session and were updated in the system according to the timeline, clearly showing the stages the groups went through to complete the course project.

4.3 RQ3: How does educational technology apply to PBL support student training in the soft skills course?

The authors analyzed data from the experimental class through observing and recording students' learning activities and collecting data from the course's LMS system. The most noticeable observation is that students' learning behaviors on the system are very transparent, providing a detailed description of the task completion process: watching lecture videos, doing self-practice exercises, and completing practical tasks. From this, the authors compared the correlation between students' self-assessment of their time management skills after completing the course and the evaluation by instructors, based on data collected from the learning activities of 84 students in the experimental class.

Looking at the results in Figure 5, it is clear that the PBL-designed learning tasks have been digitized flexibly, transforming into learning tasks on the LMS. This not only helps instructors collect objective data but also allows them to control students' submission behaviors on time through the system's built-in features: reminders via email, app notifications, etc. Furthermore, the frequency of student interaction on the system over the seven-week course period is described in detail, allowing instructors to easily access students' learning products and assess their quality. This helps evaluate the application of time management skills by each individual and provides timely support for students throughout the learning process.



LEVEL	DESCRIPTION
Excellent	Skillfully applied. Always practices through LMS tasks
Good	Capable of performing the skill but lacks flexibility. Frequently performs practice tasks on LMS
Average	Capable of performing the skill but occasionally makes mistakes. Occasionally performs practice tasks on LMS. Sometimes needs support or feedback to improve
Needs Adjustment	Has basic understanding but frequently makes mistakes. Rarely performs practice tasks on LMS. Needs frequent guidance and support

Fig. 5. Correlation comparison chart

The results show a clear discrepancy between students' self-assessment and the instructor's evaluation. In general, students tend to rate their skills higher than the instructor does. This can be easily explained by the behaviors students accumulate as they complete learning tasks on the system, which are all tracked, transparent, and objective during the evaluation process. This makes it easier for instructors to address conflicts when students have questions. Thus, educational technology supporting PBL plays a crucial role in monitoring and evaluating the quality of soft skills education for students.

4.4 Post-course survey results

After the two-week course, the authors conducted an interview survey via email with students from the experimental class regarding the time management skills learned in the soft skills course. Upon receiving feedback from students in the form of short paragraphs, the authors found that the students' responses could be grouped into three categories (see Figure 6).

Fig. 6. Results of the post-course interview

Group 1—Basic awareness: Students recognized the importance of time management skills and remembered the basic concepts, but they lacked proactivity in applying them. They understood that planning is necessary but rarely did so after completing the course due to a combination of reasons identified through their feedback: wasting time on electronic devices, online games, procrastination due to laziness, etc.

Group 2—Advanced awareness: Students developed a deeper understanding and clearly grasped the steps for developing time management skills. They were able to apply planning and prioritize tasks in some personal projects, but these practices hadn't become sustainable habits. They knew how to build a basic plan and apply it to some tasks but did not practice regularly due to distractions from external factors, an inability to control emotions, not knowing how to reject interfering tasks, etc.

Group 3—Sustained behavioral change: Students developed positive habits each week: planning, prioritizing tasks, and adjusting their schedule if unexpected tasks arose. This demonstrates flexibility in adapting to specific circumstances. One of the reasons the authors found high reliability in classifying students into this group is based on the tracking of their interactive behaviors throughout the course with frequent engagement, good completion of learning tasks, and continuous practice. This clearly shows that through hands-on practice, learners will master the skill, and it will become a new habit for them. If the course were extended to 16 weeks in the main semester, the percentage of students in this group would surely increase due to more time for skill development.

5 DISCUSSION

The experimental results show that the application of PBL has positively stimulated learners to change and improve their process of mastering knowledge. The most important aspect of PBL is creating a real-world context with a problem, guiding learners to develop personal skills and work together in groups to solve larger problems within an organization. All of this is recorded through the use of technology to assess the progress in skills before and after participating in the course. These measurable changes highlight the significant difference of PBL compared to the teaching methods currently implemented in this course. The transparent data collected also serves as compelling evidence for instructors to adjust their teaching methods and foster an environment that encourages students to develop self-learning and self-regulation skills to refine their abilities. Moreover, the positive interaction of learners through individual learning tasks demonstrates the importance of breaking down the guidance steps. With large classes, multidisciplinary and diverse learning styles, expanding the types of learning materials, such as videos, simulations, practical tasks, etc., is essential. This contributes to enhancing the personalization of learning, making it more relevant and suitable for various learning styles.

Initially, the authors designed the teaching activities closely aligned with PBL, aiming to stimulate behavioral change in students through these activities. The authors faced difficulties when transitioning these activities from face-to-face to online formats. This required the instructor to understand the system's features, incorporate multimedia teaching theories, and develop new features to optimize interactions with the LMS platform in the simplest way possible, thus reducing barriers for students to engage with learning tasks and group work, contributing to the most objective data collection. After evaluating the collected data, the author recognized the importance of practical tasks in effectively supporting learners. The system's reminder features each week helped students gradually change their behavior.

Additionally, a major challenge for the authors was selecting real-world problem scenarios relevant to multidisciplinary students and assigning groups with diverse personalities. The authors attempted to apply flexible active teaching techniques combined with the knowledge from HUST's interdisciplinary programs, aligning with the needs of organizations and businesses to build the context. The authors researched current trending issues from recruitment forums and Gen Z lifestyle forums to create the problems assigned to the groups. The LMS always provided user behavior statistics, allowing the authors to identify students encountering issues and promptly advise them to maintain their motivation to continue studying.

The results of this study provide significant practical implications for educators and management at various levels. Soft skills are essential for all students, and this is particularly emphasized at large institutions such as HUST. Blended learning formats demonstrate many strengths in addressing the challenges of educating large numbers of students, but there is a need for flexibility in using hybrid learning approaches to support students more visually in the online environment. Furthermore, renewing teaching methods to suit the specific characteristics of each subject is equally important. PBL is one of the most effective strategies to support learners in developing skills in this rapidly changing 21st century. Therefore, prioritizing investment in research to develop active learning methods, enhance management systems, and improve technological tools to seamlessly integrate online and in-person learning activities is crucial. This will maximize the benefits for learners and contribute to elevating the institution's standing in the region.

6 CONCLUSIONS

In this study, the application of PBL highlighted the importance of innovating teaching methods for the development of students' soft skills, particularly when organized in a blended learning format.

Through detailed analysis, the authors assessed soft skills as an accumulative process and recognized the superior impact of problem-based learning in practical activities compared to methods currently implemented in the course.

Problem-based learning contributes significantly to the development of teamwork and collaborative skills among multidisciplinary students by addressing real-world problems similar to the students' future work environment.

One of the limitations of this study is the absence of a single online platform used throughout the learners' learning process. This is due to the limitations of the infrastructure, which could not fully meet the requirements of the instructional design objectives. However, the authors saw this as an opportunity to demonstrate flexibility by drawing on the strengths of various technological platforms for PBL implementation, thereby contributing to the positive recognition of learner personalization and the promotion of equity in learner assessment and support based on individual characteristics.

In the next phase of research, we will continue to explore other active learning methods and look at the functionality of the LMS to select and design a variety of unified e-learning activities on a single platform. The aim is to create an accessible and consistent learning experience within the learning behavior management system for synchronous and asynchronous sessions throughout the course, ensuring that learners remain at the center of all learning activities.

7 ACKNOWLEDGEMENTS

This study was supported by HUST under the grant number T2022-PC-063. The authors would like to express their sincere gratitude to Associate Professor Le Hieu Hoc and M.A. Pham Hong Hanh for their valuable comments and constructive feedback on the manuscript.

8 REFERENCES

[1] S. Deep, B. M. Salleh, and H. Othman, "Exploring the role of problem-based learning in developing conflict Resolving and other soft skills – A quasi-experimental study," *Int. Rev. Manag. Mark.*, vol. 6, no. 4, pp. 738–748, 2016. https://www.econjournals.com/index.php/irmm/article/view/2890

[2] World Economic Forum, "The future of jobs report 2023," 2023. https://www.weforum.org/publications/the-future-of-jobs-report-2023/

[3] Y. T. Ngoo, K. M. Tiong, and W. F. Pok, "Bridging the gap of perceived skills between employers and accounting graduates in Malaysia," *Am. J. Econ.*, vol. 5, no. 2, pp. 98–104, 2015. http://article.sapub.org/10.5923.c.economics.201501.09.html

[4] S. Deep *et al.*, "The problem-based learning approach towards developing soft skills: A systematic review," *Qual. Rep.*, vol. 25, no. 11, pp. 4029–4054, 2020. https://doi.org/10.46743/2160-3715/2020.4114

[5] D. Brata and A. Mahatmaharti, "The implementation of Problem Based Learning (PBL) to develop student's soft-skills," *J. Phys. Conf. Ser.*, vol. 1464, p. 012020, 2020. https://doi.org/10.1088/1742-6596/1464/1/012020

[6] N. T. Long and N. V. Hanh, "A structural equation model of blended learning culture in the classroom," *Int. J. High. Educ.*, vol. 9, no. 4, pp. 99–115, 2020. https://doi.org/10.5430/ijhe.v9n4p99

[7] S. S. Pazhani and T. S. Priya, "Need for soft skills development towards managerial efficiency," *Int. J. Manag. Res. Rev.*, vol. 2, no. 11, p. 1895, 2012.

[8] M. Martínez Ávila, R. M. Garcia Garcia, S. Guajardo Flores, and D. Guajardo Flores, "Soft skills development in bioengineering students through problem-based learning: An analysis of educational impact," in *Leadership in Education and Innovation in Engineering in the Framework of Global Transformations: Integration and Alliances for Integral Development*, Buenos Aires, Argentina, 2023, pp. 1–8. https://doi.org/10.18687/LACCEI2023.1.1.1576

[9] MOHE (Ministry of Higher Education Malaysia), "Holdings: Modul pembangunan kemahiran insaniah (soft skills) untuk institusi pengajian tinggi Malaysia," [Online]. Available: https://library.mohe.gov.my/cgi-bin/koha/opac-detail.pl?biblionumber=2380&shelfbrowse_itemnumber=6103

[10] K. Mwita, S. Kinunda, S. Obwolo, and N. Mwilongo, "Soft skills development in higher education institutions: Students' perceived role of universities and students' self-initiatives in bridging the soft skills gap," *International Journal of Research in Business and Social Science (2147-4478)*, vol. 12, pp. 505–513, 2023. https://doi.org/10.20525/ijrbs.v12i3.2435

[11] S. Setiarini and S. Wulan, "Analysis software engineering team's soft skills learning using online learning platform with project-oriented problem-based learning (POPBL)," *Inf. J. Ilm. Bid. Teknol. Inf. Dan Komun.*, vol. 6, no. 2, pp. 81–86, 2021. https://doi.org/10.25139/inform.v6i2.3986

[12] F. Latada and H. Kassim, "Project-oriented problem-based learning (POPBL): An initiative to enrich soft skills among students at a public university," *Journal of Global Business and Social Entrepreneurship (GBSE)*, vol. 1, no. 3, pp. 75–83, 2017. https://gbse.my/v1no3jan17/Paper-046-.pdf

[13] S. Gade and S. Chari, "Case-based learning in endocrine physiology: An approach toward self-directed learning and the development of soft skills in medical students," *Adv. Physiol. Educ.*, vol. 37, pp. 356–360, 2013. https://doi.org/10.1152/advan.00076.2012

[14] J. Lhalloubi, L. Rhomari, and F. Ibnchahid, "The influence of experiential learning on the perceived employability of engineering students in their final year: The role of soft skills," *Int. J. Econ. Manag. Res.*, vol. 6, no. 8, 2024. https://doi.org/10.48379/IMIST.PRSM/mjqr-v6i4.49132

[15] S. N. Razali, H. Noor, M. Ahmad, and F. Shahbodin, "Enhanced student soft skills through integrated online project based collaborative learning," *Int. J. Adv. Appl. Sci.*, vol. 4, pp. 59–67, 2017. https://doi.org/10.21833/ijaas.2017.03.010

[16] G. Ivan, C. Pacheco, F. Méndez, and J. Calvo-Manzano, "The effects of game-based learning in the acquisition of 'soft skills' on undergraduate software engineering courses: A systematic literature review," *Comput. Appl. Eng. Educ.*, vol. 28, no. 5, pp. 1327–1354, 2020. https://doi.org/10.1002/cae.22304

[17] N. Lyz, A. Lyz, I. Neshchadim, and V. Kompaniets, "Blended learning and self-reflection as tools for developing IT-students' soft skills," in *2020 V International Conference on Information Technologies in Engineering Education (Inforino)*, 2020, pp. 1–4. https://doi.org/10.1109/Inforino48376.2020.9111723

[18] S. Jacques, S. Bissey, and A. Martin, "Multidisciplinary project based learning within a collaborative framework: A case study on urban drone conception," *Int. J. Emerg. Technol. Learn. (IJET)*, vol. 11, no. 12, pp. 36–44, 2016. https://doi.org/10.3991/ijet.v11i12.5996

[19] E. Graaff and A. Kolmos, "Characteristics of problem-based learning," *International J. Eng. Educ.*, vol. 19, no. 5, pp. 657–662, 2003. https://www.ijee.ie/articles/Vol19-5/IJEE1450.pdf

[20] H. S. Barrows, "The essentials of problem-based learning," *J. Dent. Educ.*, vol. 62, no. 9, pp. 630–633, 1998. https://doi.org/10.1002/j.0022-0337.1998.62.9.tb03223.x

[21] M. E. Ibrahim, A. M. Al-Shahrani, M. E. Abdalla, I. M. Abubaker, and M. E. Mohamed, "The effectiveness of problem-based learning in acquisition of knowledge, soft skills during basic and preclinical sciences: Medical students' points of view," *Acta Inform. Medica*, vol. 26, no. 2, pp. 119–124, 2018. https://doi.org/10.5455/aim.2018.26.119-124

[22] H. Suryanti and S. Supeni, "A problem based learning (PBL) Model in developing students' soft skills aspect," *Int. J. High. Educ.*, vol. 8, no. 8, pp. 62–69, 2019. https://doi.org/10.5430/ijhe.v8n8p62

[23] V. Tuzlukova and V. Singh, "Twenty first century skills through problem based learning: An Esp perspective," *J. Teach. Engl. Specif. Acad. Purp.*, vol. 6, no. 3, pp. 413–423, 2019. https://doi.org/10.22190/JTESAP1803413T

[24] H. Tadjer, Y. Lafifi, H. Seridi-Bouchelaghem, and S. Gulsecen, "Improving soft skills based on students' traces in problem-based learning environments," *Interact. Learn. Environ.*, vol. 30, no. 10, pp. 1879–1896, 2022. https://doi.org/10.1080/10494820.2020.1753215

[25] F. L. F. Barros and R. A. Bittencourt, "Evaluating the influence of PBL on the development of soft skills in a computer engineering undergraduate program," in *2018 IEEE Frontiers in Education Conference (FIE)*, 2018, pp. 1–9. https://doi.org/10.1109/FIE.2018.8658832

[26] A. P. Nazaré de Freitas and R. Assoreira Almendra, "Teaching and learning soft skills in design education, opportunities and challenges: A literature review," in *Developments in Design Research and Practice. Senses 2019*, in Springer Series in Design and Innovation, E. Duarte and C. Rosa, Eds., Springer, Cham, vol. 17, 2022, pp. 261–272. https://doi.org/10.1007/978-3-030-86596-2_20

[27] H. Bhati and P. Khan, "The importance of soft skills in the workplace," *J. Stud. Res.*, 2022. [Online]. Available: https://www.jsr.org/hs/index.php/path/article/view/2764

[28] Z. Kanetaki, C. Stergiou, G. Bekas, and E. Kanetaki, "Machine learning and statistical analysis applied on mechanical engineering CAD course: A case study during ERTE Pahse in the context of higher education," in *2020 4th International Symposium on Multidisciplinary Studies and Innovative Technologies (ISMSIT)*, Istanbul, Turkey, 2020, pp. 1–13. https://doi.org/10.1109/ISMSIT50672.2020.9254924

[29] Z. Kanetaki, C. Stergiou, G. Bekas, C. Troussas, and C. Sgouropoulou, "Data mining for improving online higher education amidst COVID-19 pandemic: A case study in the assessment of engineering students," in *Frontiers in Artificial Intelligence and Applications*, 2021, pp. 157–165. https://doi.org/10.3233/FAIA210088

[30] P. H. Hanh, V. D. Minh, D. T. Van, and N. T. T. Tu, "Proposal for applying problem-based learning in soft skills training at Hanoi University of science and technology," *Am. J. Educ. Res.*, vol. 11, no. 12, pp. 810–816, 2023. [Online]. Available: https://www.sciepub.com/EDUCATION/abstract/15731

[31] H. Ma and L. Chen, "Time management disposition mediates the influence of childhood psychological maltreatment on undergraduates' procrastination," *Psychol. Res. Behav. Manag.*, vol. 15, pp. 1489–1494, 2022. https://doi.org/10.2147/PRBM.S367446

[32] A. Basith, Md. S. Rahman, and U. Moseki, "College students' academic procrastination during the Covid-19 pandemic: Focusing on academic achievement," *J. Kaji. Bimbing. Dan Konseling*, vol. 6, no. 3, pp. 112–120, 2022. https://doi.org/10.17977/um001v6i32021p112-120

[33] M. Romero, J. F. Juola, C. Casadevante, J. M. Hernández, and J. Santacreu, "Are mastery-oriented college students better time managers?" *Trends Psychol.*, vol. 30, pp. 384–399, 2022. https://doi.org/10.1007/s43076-021-00096-w

[34] M. Hismanoglu and I. Uz, "Investigating Turkish EFL learners' time management skills in relation to some learner variables," *Int. Online J. Educ. Teach.*, vol. 8, no. 4, pp. 2266–2275, 2021.

[35] K. Črnjar, V. Čikeš, and K. Ferenčak, "The assessment of the time management skills in Chinese and Croatian students," *Zb. Veleuč. U Rijeci*, vol. 7, no. 1, pp. 83–94, 2019. https://doi.org/10.31784/zvr.7.1.3

[36] B. Claessens, W. Eerde, C. Rutte, and R. Roe, "A review of time management literature," *Pers. Rev.*, vol. 36, no. 2, pp. 255–276, 2007. https://doi.org/10.1108/00483480710726136

[37] W. Suzanne, A. Riley, and P. Flom, "Assessment of time management skills (ATMS): A practice-based outcome questionnaire," *Occup. Ther. Ment. Health*, vol. 29, no. 3, pp. 215–231, 2013. https://doi.org/10.1080/0164212X.2013.819481

[38] M. Bond and N. Feather, "Some correlates of structure and purpose in the use of time," *J. Pers. Soc. Psychol.*, vol. 55, no. 2, pp. 321–329, 1988. https://doi.org/10.1037/0022-3514.55.2.321

[39] B. K. Britton and A. Tesser, "Effects of time-management practices on college grades," *J. Educ. Psychol.*, vol. 83, no. 3, pp. 405–410, 1991. https://doi.org/10.1037/0022-0663.83.3.405

[40] T. Macan, "Time management: Test of a process model," *J. Appl. Psychol.*, vol. 79, no. 3, pp. 381–391, 1994. https://doi.org/10.1037/0021-9010.79.3.381

[41] I. Lykourentzou, A. Antoniou, Y. Naudet, and S. Dow, "Personality matters: Balancing for personality types leads to better outcomes for crowd teams," in *Proceedings of the 19th ACM Conference on Computer-Supported Cooperative Work & Social Computing (CSCW '16). Association for Computing Machinery*, New York, NY, USA, 2016, pp. 260–273. https://doi.org/10.1145/2818048.2819979

[42] A. E. Colbert, M. R. Barrick, and B. H. Bradley, "Personality and leadership composition in top management teams: Implications for organizational effectiveness," *Pers. Psychol.*, vol. 67, no. 2, pp. 351–387, 2014. https://doi.org/10.1111/peps.12036

9 AUTHORS

Thi Van Dang is a PhD Candidate at Faculty of Education, Hanoi University of Science and Technology (HUST), No.1 Dai Co Viet Street, Hai Ba Trung District, Hanoi, Vietnam. Her research interests include STEM Education, Teacher Competencies, Open and Distance Learning, e-Learning, Learning Management Systems (E-mail: Van.DangThi@hust.edu.vn).

Phung Tran Gia Bao is a student at the Faculty of Education, Hanoi University of Science and Technology (HUST), located at No. 1 Dai Co Viet Street, Hai Ba Trung District, Hanoi, Vietnam. His research focuses on Educational Technology, Multimedia Design and the Application of Multimedia in Teaching and Learning (E-mail: bao.ptg212285@sis.hust.edu.vn).

Vu Dinh Minh is a Lecturer at Faculty of Education, Hanoi University of Science and Technology (HUST), No.1 Dai Co Viet Street, Hai Ba Trung District, Hanoi, Vietnam. His research focuses on Educational Technology, eLearning and Data Mining (E-mail: minh.vudinh@hust.edu.vn).

Nguyen Thi Thanh Tu is a Lecturer at the Faculty of Education, Hanoi University of Science and Technology (HUST), No.1 Dai Co Viet Street, Hai Ba Trung District, Hanoi, Vietnam. Her research focuses on Educational Technology, eLearning and Software Engineering (E-mail: tu.nguyenthithanh@hust.edu.vn).