**RESEARCH ARTICLE**　　　　　　　　　　　　　　　　　　　　　　　**OPEN ACCESS**

# Comparison of Problem-solving Skills in the Traditional Face-to-Face Classroom and Online Learning in Postgraduate Courses of Education Management

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**Abstract:**

*Background:* The COVID-19 pandemic has changed the paradigm in education due to mandatory online learning during the quarantine period. Hybrid learning is now another required learning tendency. Hence, the pandemic provided a chance to access students' learning outcomes to different types of attendance from on-site to online formats.

*Objective:* This study aimed at comparing problem-solving skills in traditional face-to-face classrooms with online learning settings in postgraduate courses in education management. Problem-solving skills are comprised of self-confidence, critical thinking, and creative problem-solving (CPS).

*Methods:* A questionnaire was used to investigate 127 master's students, including 64 students in the traditional face-to-face classroom and 63 in the online format.

*Results:* The results showed that the online setting had significantly better performance in terms of high confidence and problem-solving than the postgraduates in the traditional face-to-face classroom.

*Conclusion:* High problem-solving confidence significantly affects positive critical thinking and CPS in both learning settings, but low self-confidence does not significantly impact the two skills in both learning settings.

**Keywords:** Problem-solving skills, Traditional face-to-face classroom, Online learning, Postgraduate education management, COVID-19, Hybrid learning.

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## 1. INTRODUCTION

The COVID-19 pandemic has changed the paradigm in education due to the mandatory shift to online learning during the quarantine period [1, 2]. Educational activities suddenly moved from on-site to online [3]. Hybrid learning has now become a significant trend [4]. However, the traditional physical classroom setting has remained largely unchanged for a long time; active classrooms, in particular, promote meaningful learning and lead to positive learning outcomes [1, 5]. This model has been combined with blended and online learning to meet the needs of those who cannot accommodate the demands of physical classroom learning [6, 7]. Thus, the pandemic provided an opportunity to assess students' learning outcomes across different types of attendance, from on-site to online formats [8].

Problem-solving has been considered one of the key 'employability skills' [9] needed to train students for their

future personal and professional lives [10]. Students should be able to collaborate with others both domestically and globally to solve everyday problems [11]. This necessity was highlighted during the pandemic [12]. Therefore, graduates must acquire problem-solving skills to be prepared for a fast-changing workforce shaped by global alliances and the digital revolution [9, 10, 13].

Higher education plays an important role in developing individuals with critical skills to participate autonomously and communally in finding solutions to complex environmental, social, and economic problems [14, 15]. Universities need to ensure that their graduates possess essential skills in communication, critical thinking, problem-solving, research, and teamwork to help them face the rapidly changing demands of society [16]. This is associated with competence or skills-based higher education [17], implying that students acquire specific skills throughout their degree programs [18]. Postgraduates in the field of education management are guided to become educational leaders; they should be able to confidently solve complex problems creatively and critically for a future workforce that is constantly changing due to global pandemics and digital transformation [10].

Thus, considering future human capital, the need for universities to equip graduates with self-confidence, critical thinking, and creative problem-solving skills for the challenging workforce ahead are crucial [19, 20]. Students' confidence in their capability to solve problems is related to the creative thinking ability needed for resolving innovative, real-world problems in the workplace [21]. Confidence is increasingly important in the face of global competition [22]. If students have a low level of self-confidence, they may not be able to present solutions [23]. In contrast, students with a high level of self-confidence are better equipped to solve problems when facing challenges [19, 24]. Critical thinking involves the development of students' reasoning approaches to problem-solving, including the processes of analyzing, synthesizing, and evaluating information to reach an answer or conclusion [25]. Creative problem solving (CPS) is the skill related to addressing new challenges in complex digital-based settings, working cooperatively with team members, facilitators, and clients as professional problem-solvers [26].

Problem-solving skills are key competencies for postgraduate students in the field of education management, preparing them to become future leaders in educational institutions [10]. Universities have a social responsibility to provide quality training that is suitable for student profiles [27] and to advance effective and innovative instructional approaches [28]. Comparing physical face-to-face classroom learning with other learning formats requires additional empirical research to identify its organizational essentials [1, 29, 30]. Hence, this study aimed to compare the differences in problem-solving abilities of postgraduate students in education management courses between traditional face-to-face classroom learning with physical attendance and a virtual online format.

## 2. LITERATURE REVIEW

This study first identified the distinctions between traditional face-to-face classroom settings and online learning modes. Next, studies on self-confidence, critical thinking, and creative problem-solving skills were reviewed for their key principles, forming the basis for conceptualizing the theory of this research.

### 2.1. Traditional Face-to-face Classroom Setting and Online Learning Formats

According to the definition of a physical face-to-face classroom setting, it is a teaching approach where the course content and learning materials are delivered personally to a class of students [29]. It has been the favored instructional method for students [31] and the most common educational approach, where the students share a physical space with the instructors, allowing for constant interaction [6]. The interaction between the students and the teacher in the classroom enables immediate communication and feedback [1].

Online learning is defined by Lee [32] as teaching and learning that do not occur in a traditional classroom setting; it encompasses distance learning, distributed learning, or e-learning. In the context of higher education, the online learning format refers to conducting courses entirely online; however, blended methods that combine online activities and face-to-face teaching have been widely applied [33, 34]. Online education is delivered in an online setting using the internet for instruction and learning, and students are not dependent on their physical or virtual co-site. The course content is delivered online, and teachers create modules that enhance learning and interactivity in synchronous or asynchronous settings [35].

### 2.2. Problem-solving Skills

Academic problem-solving refers to the process of solving various types of problems by applying a set of rules and heuristics [36]. Modern problem-solving involves how the presentation of a problem interacts with students' prior knowledge in a specific academic discipline [37]. Problem-solving occurs when individuals face a task whose method for achieving the desired outcome is unclear [38]. Problem-solving happens in daily life and can include everything from finding directions to a new location to determining the best approach to handle a complex work challenge [36]. A problem is a task that requires accomplishment; therefore, to solve a problem, a person must have the necessary skills to address it [39].

Self-confidence is a crucial factor in enhancing students' problem-solving skills [40, 41]. Gok [24] developed and validated a classification of problem-solving confidence into 'high confidence' and 'low confidence'. This classification was applied by Chen [19] in a research experiment with graduates in education management. The findings revealed that students with high confidence achieved significantly better results in solving tasks during academic training compared to those with low confidence. Students engage in learning practice through repeated activities, memorization, comprehension, and reflection.

These processes require them to think critically in order to achieve successful learning outcomes and, consequently, enhance their problem-solving skills [20]. Critical thinking involves the process of reflection, including making assumptions, comparisons, and evaluations, and discovering a deep understanding related to specific knowledge approaches to problem-solving [42, 43].

Students are trained to assess the pros and cons before determining how to resolve a problem. This process also involves a creative approach and innovative perspective in solving problems [20]. This is Creative Problem Solving (CPS), defined as an efficient approach to inclusive cognition based on an essential creative process that consciously stimulates creative thinking and, therefore, generates creative solutions and transformation [44]. Moreover, it deliberately fosters the type of thinking needed to solve complex problems [45]. The process of CPS consists of identifying and defining problems, discovering and assessing solutions, and executing the plan [10]. Hence, the development of problem-solving skills involves self-confidence, critical thinking, and creative problem-solving. Students enhance their problem-solving skills through academic courses.

### 2.3. Hypotheses

A physical face-to-face classroom setting has been regarded as the most common model for exploring meaningful learning [46] and problem-solving skills with students [1]. Chen [19] found that students with high self-confidence in problem-solving performed significantly better than those with low self-confidence in traditional face-to-face classroom learning. A low level of problem-solving confidence may discourage effective problem-solving [47]. Learners identify and reflect on what they have obtained in the classroom, as these practices guide higher-order thinking in resolving problems, as shown in the paradigm of critical thinking and problem-solving [48]. Chen and Chang [10] found that students could apply Creative Problem Solving (CPS) effectively through project-based learning in physical classroom settings.

However, online learning places less demand on turn-taking and enables multiple students to communicate and even engage in multiple discussions simultaneously. This also allows students more time to frame and organize their ideas and thoughts before proposing a statement or raising a question [49, 50]. If students in online learning have more experience within the corresponding pedagogical experiments than those in the physical face-to-face classroom format, they may have already developed a better ability to think 'outside the box,' leading to unpredictable strategies when approaching problem-solving [12]. Tabvuma [8] claims that after students received time management training, they performed more successfully in online learning settings. Hence, the hypotheses of this research are proposed as follows.

#### 2.3.1. Hypothesis 1

The problem-solving skills of students are significantly different between the traditional face-to-face classroom setting and online learning formats.

#### 2.3.2. Hypothesis 2

The problem-solving skills of students in online learning environments perform significantly better than traditional face-to-face classroom placement.

#### 2.3.3. Hypothesis 3

High problem-solving confidence in students positively affects their critical thinking and CPS.

### 3. MATERIALS AND METHODS

This study used questionnaires to investigate differences in problem-solving skills among postgraduate students in education management courses between traditional face-to-face classroom learning and online learning settings. After students completed the course, data were collected using a questionnaire survey and analyzed through t-tests and regression analysis. The independent variables were traditional face-to-face classroom settings and online learning formats. The dependent variables were problem-solving skills, including self-confidence and critical and creative problem-solving. A total of 127 graduate students in the education management program participated in the research. The details of the methodology are shown below.

### 3.1. Participants

This study took place at a private university in Bangkok, Thailand. A total of 127 master's students in the education management program agreed to participate. This university implemented full online learning during the COVID-19 pandemic. Before January 2020, the university conducted traditional face-to-face classroom learning. From January 2020 to April 2022, online learning was fully implemented for the sake of COVID-19 sanitation and the health and safety of both students and instructors. The required duration of courses was 15 lessons of 3 hours each, totaling 45 hours. The researchers of this study notified the participants about the objectives of the investigation and invited them to fill in an informed consent agreement before conducting the survey. The questionnaire was conducted at the end of each course in two stages. The first stage focused on the traditional face-to-face classroom setting, involving 64 students, including 25 males (39.1%) and 39 females (60.9%), in November 2019. The second stage focused on the online learning format in August 2021, with 63 students participating, including 28 males (44.4%) and 35 females (55.6%). In total, there were 53 male students and 74 female students, with a gender ratio of 4:6.

### 3.2. Measurements

The study applied three questionnaires for the investigation, including the problem-solving confidence questionnaire (PSCQ) by Gok [24], the perceptions of critical thinking and problem-solving questionnaire (PCTPSQ) by Rodzalan and Saat (2015), and the creative problem-solving questionnaire (CPSQ) by Laio [51]. The details of each questionnaire are shown below.

### 3.3. Problem-solving Confidence Questionnaire

The PSCQ was developed by Gok [24]. The objective was to justify the questionnaire and support scholars to identify the problem-solving confidence of learners more specifically. The dimensions in the PSCQ were classified into 'high confidence' and 'low confidence'. There are 19 items with the five-point Likert scale for the answers of the responders from 1 = Strongly disagree to 5 = Strongly agree. High confidence has 14 items and low confidence includes five items. The reliability test was conducted. The alpha coefficient for high confidence was .906 and for low confidence was .816. The overall alpha coefficient was .784. The alpha coefficient had a relatively internal consistency.

### 3.4. Perceptions of Critical Thinking and Problem-solving Questionnaire

The PCTPSQ was developed by Rodzalan and Saat [20]. The aim was to identify perceptions of critical thinking and problem-solving among students. There are 9 items of questions without sub-category dimensions with the five-point Likert scale for the answers of the participants from 1 = Strongly disagree to 5 = Strongly agree. The assessment of reliability for two learning formats revealed that the alpha coefficient was .733, implying a fair internal consistency.

### 3.5. Creative Problem-solving Questionnaire

The CPSQ was constructed by Laio and the team [51] when they implemented an instructional experiment to develop college students' CPS. The questionnaire was designed with 26 items categorised into five dimensions,

including identifying and defining problems, finding and evaluating the solution, and implementing the plan, and it was set on a five-point Likert scale ranging from 1 = Strongly disagree to 5 = Strongly agree. The test of reliability for the two settings showed that the alpha coefficient was 0.928, indicating a comparatively high internal consistency.

### 4. RESULTS

In terms of the research objective of this study, we mainly compared the problem-solving skills of the graduate students in the courses of educational management between the traditional face-to-face classroom and online learning settings. A t-test was applied to the statistical data analysis for the comparison. Regression analysis was used for further investigation. The results are presented below.

### 4.1. Differences in Problem-solving Skills between Two Learning Settings

Hypotheses 1 and 2 were supported. A t-test was conducted to compare differences in problem-solving skills of the students between the setting of the traditional face-to-face classroom and the format of online learning, and better performance from students in the online setting, as shown in Table **1**. The results revealed significant differences in high confidence (Mclassroom = 3.63, Monline = 4.002, p < .001) and overall skills (Mclassroom = 3.542, Monline = 3.707, p < .01), indicating that the graduate students in the online learning format performed better on overall problem-solving ability in general than the students in the traditional face-to-face classroom setting.

**Table 1. Analysis of differences in problem-solving skills between two learning settings.**

| Variables | Settings | n | *M* | *SD* | *t* | *p* |
|---|---|---|---|---|---|---|
| High confidence | Classroom | 64 | 3.63 | .517 | -4.099 | .000 |
| | Online | 63 | 4.002 | .504 | | |
| Low confidence | Classroom | 64 | 3.121 | .711 | -.207 | .836 |
| | Online | 63 | 3.149 | .776 | | |
| Critical thinking | Classroom | 64 | 3.666 | .440 | -1.515 | .132 |
| | Online | 63 | 3.783 | .425 | | |
| Creative problem-solving | Classroom | 64 | 3.751 | .441 | -1.729 | .086 |
| | Online | 63 | 3.895 | .494 | | |
| Overall | Classroom | 64 | 3.542 | .240 | -3.041 | .003 |
| | Online | 63 | 3.707 | .357 | | |

**Table 2. Analysis of differences in cps between two learning settings.**

| Variables | Settings | n | *M* | *SD* | *t* | *p* |
|---|---|---|---|---|---|---|
| Identifying problems | Classroom | 64 | 3.71 | .564 | -.286 | .775 |
| | Online | 63 | 3.74 | .641 | | |
| Defining problems | Classroom | 64 | 3.932 | .603 | -2.012 | .046 |
| | Online | 63 | 4.137 | .544 | | |
| Finding the solution | Classroom | 64 | 3.775 | .502 | -1.864 | .056 |
| | Online | 63 | 3.949 | .550 | | |

*(Table 4) contd.....*

| Variables | Settings | n | M | SD | t | p |
|---|---|---|---|---|---|---|
| Evaluating the solution | Classroom | 64 | 3.603 | .549 | -2.653 | .009 |
| | Online | 63 | 3.857 | .529 | | |
| Implementing the plan | Classroom | 64 | 3.863 | .582 | -1.751 | .082 |
| | Online | 63 | 4.039 | .552 | | |

Table **2** shows the further analysis of CPS, which had significant differences in defining problems (Mclassroom = 3.932, Monline = 4.137, p < .05) and evaluating the solution (Mclassroom = 3.603, Monline = 3.857, p < .01), indicating that the postgraduates in the online learning settings had better skills to explain confronting problems and assessing the outcomes. However, there was no significant difference in low confidence between the two learning settings, implying that when the students had low confidence to solve tasks, their performance of problem-solving ability was approximately the same regardless of the learning environment.

## 4.2. Effects of Problem-solving Confidence on Critical Thinking and CPS

Hypothesis 3 was supported. Multiple regression analyses of critical thinking and CPS scores between two learning settings were conducted against the predictor variable, problem-solving confidence, and the results demonstrated that all the assumptions of the multiple regression analyses had been met. A summary of the regression analysis of master's students' critical thinking and CPS scores can be seen in Tables **3** and **4**. The significant predictor of critical thinking (on-site), in the declining direction of beta coefficients, was high confidence (β=.406, $t$=3.105, $p$=.003), which explained 32.1% of the variation, indicating that the students' high confidence positively affected their critical thinking. In the online setting, the significant predictor of critical thinking in

reducing demand of beta coefficients was high confidence (β=.617, $t$=5.989, $p$=.000), which explained 35.4% of the variation, indicating that the students' high confidence positively influenced their critical thinking. However, low confidence did not have a significant impact on critical thinking in both learning settings.

The significant predictor of CPS (on-site), in decreasing order of beta coefficients, was high confidence (β=.452, $t$=3.468, $p$=.001), which explained 32.6% of the variation, implying that high confidence positively motivated CPS in the face-to-face classroom. The significant predictor of CPS (online) in lowering the order of beta coefficients was high confidence (β=.754, $t$=8.783, $p$=.000), which explained 55.2% of the variation, implying that high confidence positively influenced CPS in the online format. However, low confidence did not have a significant effect on CPS in both learning settings.

## 5. DISCUSSION

The aim of this study was to compare the effects of problem-solving skills on graduate students in education management courses across two types of learning settings: traditional face-to-face classrooms with physical attendance and online learning. The key aspects of problem-solving skills in this study included self-confidence, critical thinking, and creative problem-solving. Drawing on the literature, we proposed and tested three hypotheses. The findings were as follows:

**Table 3. Regression analysis of problem-solving confidence's prediction of critical thinking.**

| Variables | Critical Thinking (on-site) | | | Critical Thinking (online) | | |
|---|---|---|---|---|---|---|
| | β | t | p | β | t | p |
| High confidence | .406 | 3.105 | .003 | .617 | 5.989 | .000 |
| Low confidence | -.242 | -1.853 | .069 | .113 | 1.093 | .279 |
| *Adj. $R^2$* | .321 | | | .354 | | |
| F | 15.922*** | | | 17.977*** | | |

**Note:** For the prediction of critical thinking, *Adj. $R^2$*=Adjusted $R^2$; *β* = standardized regression coefficients.
***$p$<.001.

**Table 4. Regression analysis of problem-solving confidence's prediction of CPS.**

| Variables | CPS (on-site) | | | CPS (online) | | |
|---|---|---|---|---|---|---|
| | β | t | p | β | t | p |
| High confidence | .452 | 3.468 | .001 | .754 | 8.783 | .000 |
| Low confidence | -.193 | -1.481 | .144 | .009 | .102 | .919 |
| *Adj. $R^2$* | .326 | | | .552 | | |
| F | 16.235*** | | | 39.155*** | | |

**Note:** For the prediction of critical thinking, *Adj. $R^2$*=Adjusted $R^2$; *β* = standardized regression coefficients.
***$p$<.001

The first finding showed that the two different learning settings had a significant effect on students' problem-solving skills. The students in the online learning format performed better in problem-solving abilities than those in the traditional face-to-face classroom setting, particularly in terms of high confidence. This is somewhat inconsistent with previous research [10, 19], which found that students' self-confidence and CPS showed distinctive outcomes in physical classroom settings *via* active and project-based learning but did not compare these findings with the online learning format. According to previous studies, the online setting fosters resolution, judgment co-creation, and solution sharing and enhances learning efficiency in a course. Previous studies have also assessed how the online format may lead to beneficial results for students in higher education [19, 50, 52], empowering students to become better critical thinkers regarding problem-solving [12].

Correspondingly, another finding illustrated that problem-solving confidence can predict the effect on critical thinking and CPS. Higher problem-solving confidence of the master's students can positively impact their critical thinking and CPS in both face-to-face classroom and online learning settings. However, low problem-solving confidence cannot predict the performance of critical thinking and CPS of master's students in both settings. Notwithstanding, previous research indicated that the low confidence of the students could negatively influence their critical thinking and CPS in the traditional face-to-face classroom [24]. The setting of a traditional face-to-face classroom provides the factor of direct interactions among students with their peers and teachers without time-space delay [1], which could be assumed to affect both high and low confidence in students' performance. It suggests that increasing the high confidence in problem-solving among postgraduates can have a causal effect on their critical thinking and CPS, which are expected to increase their problem-solving ability [19, 42].

## CONCLUSION

This study compared problem-solving skills between traditional face-to-face classrooms and online learning formats in postgraduate education management courses. Potential educational leaders should be trained to become confident, complex problem-solvers capable of addressing and resolving complicated issues critically and creatively, especially in the context of unexpected pandemics, climate change, and the digital age [10, 19]. Hence, we investigated the problem-solving skills of graduate students in education management courses in both physical attendance classrooms and online classes. We identified the components of problem-solving skills, including self-confidence, critical thinking, and creative problem-solving, drawing on previous research [10, 19, 20, 24, 42, 46, 47]. Additionally, the differences between traditional face-to-face classrooms and online learning settings were explored based on the literature.

The findings revealed that students in online learning exhibited higher confidence and problem-solving ability than those in traditional face-to-face classrooms. In traditional teaching, teachers and students can interact immediately in the classroom, but online learning has significantly restricted teacher-student interaction. During the pandemic, assigning group assignments became the most common method of interaction [53, 54]. Students studying online can develop their ability to learn independently through homework activities and address learning difficulties through discussions with classmates [55]. Online settings enhance course learning through interactivity in synchronous or asynchronous formats [35], allowing students to engage in more discussions than on-site [56]. Learners can follow up with discussions at their own pace [51], which allows for tailored learning processes. Tailored learning can provide more benefits for learners than teacher-controlled instruction [57]. In contrast, traditional face-to-face classrooms must design more social networks through student collaborations [46]. For example, applying concept mapping to specific topics to study the coherence of knowledge forms [58], examining epistemic networks of student explanations to solve computational problems [59], and analyzing social and conceptual networks by following the flow of ideas in a dialogue among learners [60] should be encouraged. These methods can enhance students' problem-solving skills better in physical classroom settings.

## IMPLICATIONS

The findings of this study revealed specific empirical differences in problem-solving skills in educational management courses between traditional face-to-face classrooms and online learning settings. The learning environment affects students' problem-solving skills [61]. These findings can be beneficial for higher education institutions, scholars, instructors, and researchers, especially in postgraduate programs in the management area, who value the design and application of learning settings in traditional face-to-face classrooms, online, or hybrid modes to effectively develop master's students' problem-solving skills [6, 7] and leadership training oriented towards problem-solving learning [10, 19].

Theoretically, we identified the definitions of traditional face-to-face classroom settings and online learning formats. Furthermore, we classified factors of students' problem-solving skills, including self-confidence, critical thinking, and creative problem-solving. Practically, we explored different learning outcomes related to problem-solving skills in postgraduate management courses between traditional face-to-face classroom settings and online formats. In the context of the global COVID-19 pandemic, educational learning settings have shifted from physical classroom attendance to virtual online participation and hybrid settings [1], highlighting the research gap regarding learning effectiveness in these new environments [62]. The findings of this research can provide a useful reference for designing and conducting appropriate learning settings to develop students' problem-solving skills.

## LIMITATIONS

This study has limitations. The sample size was small because this research only examined the postgraduate course of education management in a single college. Therefore, the findings can be generalized to the general population in relevant fields of academic disciplines in a limited way. We recommend expanding the sample to investigate master's students' problem-solving abilities in diverse academic disciplines [36]. Furthermore, problem-solving skills in leadership training are tailored towards pedagogical development [10, 19]. In future research, surveys of blended teaching can be added to compare the problem-solving abilities of students in management-related fields across different learning environments. Further, this would provide valuable references for educational institutions when choosing future teaching methods.

## AUTHORS' CONTRIBUTIONS

It is hereby, confirmed that all authors take responsibility for the manuscript's content and agree to its submission. The authors have reviewed all results and unanimously approved the final version of the manuscript.

## LIST OF ABBREVIATIONS

CPS      = Creative Problem-solving

PSCQ    = Problem-solving Confidence Questionnaire

PCTPSQ = Perceptions of Critical Thinking and Problem-solving Questionnaire

## ETHICS APPROVAL AND CONSENT TO PARTICIPATE

Ethical approval for this study was obtained from the office of Dhurakij Pundit University, Thailand Human Research Ethics Committees. (DPUHREC072/65NA).

## HUMAN AND ANIMAL RIGHTS

All procedures performed in studies involving human participants were in accordance with the ethical standards of institutional and/or research committee and with the 1975 Declaration of Helsinki, as revised in 2013.

## CONSENT FOR PUBLICATION

Participants provided informed consent for the publication.

## STANDARDS OF REPORTING

STROBE and SAGER guidelines were followed.

## AVAILABILITY OF DATA AND MATERIAL

The data and supporting information are contained within the article.

## FUNDING

None.

## CONFLICT OF INTEREST

The authors declare no conflict of interest, financial or otherwise.

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