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PAPER

Reflective Thinking on Enhancing Student Competencies in Learning Management through Outcome-Based Learning According to Constructive Alignment

Akkarat Poolkrajang, Rinradee Papanai(✉)

Faculty of Technical Education, Rajamangala University of Technology Thanyaburi, PathumThani, Thailand

rinradee_p@rmutt.ac.th

ABSTRACT

This study investigates the implementation of learning outcomes-based education in mechanical engineering, focusing on students aspiring to pursue teaching careers. By using constructive alignment and reflective thinking methodologies, the study aims to enhance these students' competencies in line with professional teaching standards. The study targets a group of 23 mechanical engineering students. The researcher's established learning process forms the basis for the study methodology, incorporating learning objectives, active learning, and reflective thinking. The tools employed include a knowledge measurement test, activity evaluation through observation participation, follow-up on a permitted 5-level activity, reflection on learning experiences through writing, structuring learning activities in each subject, and assessment using qualitative content analysis. The results reveal significant variations in students' academic achievements before and after the study, indicating moderate learning progress. The assessments of management learning performance are comprehensive, with learners engaging at the highest average level. This study underscores the significance of reflective learning approaches in developing competencies that align with professional teaching standards, enhancing students' capacity to critically assess their thoughts, feelings, and attitudes, thereby influencing their actions and preparing them for real-world applications.

KEYWORDS

reflective thinking, student competencies, learning management, outcomes-based learning, mechanical engineering, constructive alignment

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1 INTRODUCTION

It is critical to develop human potential and capabilities in a global society, particularly by focusing on acquiring skills, knowledge, abilities, and competencies that align with labor market demands and national development goals [1]. It is argued that sustainability capabilities should be grounded in a comprehensive, forward-thinking approach to addressing current economic and social challenges. Consequently, modern educational management needs to adapt to match workforce production and development trends while also taking into account social needs and professional practices. The teaching profession plays a crucial role as it emphasizes continuous learning, leadership in learning communities, and the application of knowledge and skills for personal and societal growth. The key skill set, 'learning skills,' encompasses information, abilities, and foundational skills [2]. It is acknowledged that collaborative learning skills are advantageous and effective, evolving due to changes in teaching and learning management as well as other supportive factors. To ensure educational institutions are managed efficiently and effectively, it is essential to cultivate teachers who can function proficiently and professionally.

Teachers play a critical role in enhancing education quality, especially in designing teaching activities and promoting educational management to assist students in acquiring the knowledge, skills, competencies, and traits specified in the curriculum. Teacher development is crucial for enhancing teaching standards, as education is fundamental to the educational process. Therefore, it is imperative to continuously enhance teacher quality, as teachers are pivotal in advancing and fostering student learning [3]. Emphasizing the significance of teachers' continuous professional growth, which necessitates them to be lifelong learners and mold individuals for societal and national progress. Teachers should possess knowledge, skills, professionalism, a passion for teaching, and a dedication to ethical standards. However, past teacher training has faced challenges in producing teachers with the qualities demanded by society. Challenges include inadequate training conditions for teachers and a lack of integration of instructional management with local customs and communities, hindering the development of appropriate professional traits in real-world scenarios [4]. According to Pendergast et al. (2023), the key challenge is to enhance the quality of teacher training by consistently updating technology and refining the learning process, as recent graduates lack specific skills, profound subject expertise, and genuine enthusiasm for the teaching profession. Assisting teachers in teaching effectively and influencing student learning is part of today's educational landscape [5]. It is also noted that teachers often encounter difficulties in engaging students, establishing conducive learning environments, and effectively managing classrooms. They may also struggle to demonstrate essential teaching abilities. These challenges may stem from the teacher education selection process, which prioritizes quantity over quality, as well as a curriculum that concentrates on theoretical subjects rather than cultivating fundamental teaching competencies [6].

The technical education curriculum in mechanical engineering aims to produce teacher trainees who excel in both the teaching profession and technical skills. Its objective is to equip students with the knowledge and skills necessary to advance their teaching careers in vocational education, focusing on systematic thinking and practical problem-solving. Coordination and practical problem-solving skills are essential for success in the engineering profession [7]. The curriculum instills a positive attitude towards teaching, nurtures educators' potential and talents, and promotes continuous learning and academic leadership. It adheres to the principles and

ethics of the teaching profession to enhance the quality of teacher trainees. The curriculum also encourages the development of teaching methodologies that enhance critical thinking, study skills, and independent information acquisition from various sources, emphasizing learning through real-world experiences and practical applications [8].

Outcome-based learning management is a strategic method designed to ensure that learners develop competencies that are relevant to graduate employers' needs, allowing graduates to effectively meet job requirements. The primary goal is to design learning objectives, educational processes, and assessment methodologies to establish expected learning outcomes (ELOs) while meeting the needs of all stakeholders [9]. Learning outcomes are defined as the knowledge, values, and competencies that students should possess after completing their education. This approach consists of three steps: 1) defining learning outcomes, 2) determining assessment methods, and 3) designing learning management plans [10]. The OLE model employs a comprehensive teaching method based on professional curricula, creating an effective vocational program with a strong subject focus and an engaging learning environment that is collaborative and consistent with the course, applicable policies, and adequate learning time [11]. Using constructive alignment in outcome-based learning management helps to generate student learning outcomes that align with professional standards established by the Teachers' Council and the National Higher Education Qualifications Framework. The goal is to analyze and improve students' competencies in managing education based on learning outcomes, using constructive alignment.

Currently, teaching management in the professional field does not yield clear results. The student-teacher relationship lacks an understanding of outcome-based learning. Consequently, the teaching experience in educational institutions fails to provide proper guidance, resulting in students relying on their professional performance. This study question focuses on how to effectively manage learning that emphasizes both the learning process and outcomes, as well as how to evaluate student learning management to achieve desired learning outcomes.

As a result, increasing the competencies of mechanical engineering student teachers to align with national development needs is an important objective for universities. This study focuses on improving these competencies using outcome-based learning management that incorporates reflective thinking, a critical component in educating effective teachers to contribute to society and the nation.

2 LITERATURE REVIEW

2.1 Reflective thinking

Reflective thinking is defined as the practice of thoughtfully considering and contemplating one's beliefs or knowledge, including the underlying justification for such reasoning. It entails verbal and written expression, problem-solving, and self-improvement, all of which lead to better work performance. According to Horton and Sherwood (2017), it is a learning management strategy that improves learners' capacity to grasp, differentiate, and express situations, hence facilitating perspective change [12]. Reflective thinking demands active participation in situations that enable critical examination. Safari (2020) asserts that reflection is required to relate to previous experiences, probe learned knowledge, and question learning [13]. Cheng (2020) notes that reflection can happen during or after an action, resulting in a

collection of personal learning experiences [14]. Van Velzen (2016) states that reflective thinking is a high-level cognitive skill as it necessitates continuous awareness of challenges. Reflective problem-solving entails determining what happened correctly and incorrectly to adjust [15]. Karaoglan-Yilmaz et al. (2013) indicate that reflection, problem-solving abilities, and a community of inquiry all predict academic and subdimensional self-awareness, including student involvement, social standing, and knowledge application [16]. Bunto R. (2019) outlines five stages of reflective learning activity: Stage 1, introduction to learning; Stage 2, experience accumulation; Stage 3, reflection connection; Stage 4, summary of principles through creating learning records; and Stage 5, practical practice [17]. Oo et al. (2013) suggest that reflection is provided through a trial-and-error teaching process that involves planning, practice, reflection, and evaluation [18]. Atchia (2023) applied the proposed reflection model to identify limitations in the student's current practices by analyzing (1) critical incidents that occurred during practical biology lessons at the undergraduate level, (2) the student's voice through informal conversations, and (3) the comments of the assigned external observers [19].

Reflective thinking in learning management should incorporate formative evaluation for development and summative assessment at the end to assess learning outcomes. Assessment results are critical for modifying learning management strategies, instructors' questioning approaches, learning experience organization, and providing learning support to meet students' needs. This facilitates the achievement of course learning outcomes through reflective thinking [20].

In summary, students engage in reflection primarily through their own experiences with learning theory and practice, as well as by analyzing what they observe before sharing it with others through speech and writing. Reflection is an important practice that allows students to develop their intellectual abilities. It facilitates the development of effective self-learning and the proper resolution of any problems that arise. Reflective thinking is a concept that encourages students to analyze and scrutinize their thoughts, feelings, attitudes, and underlying beliefs, which influence their behavior in a variety of situations. It seeks to comprehend the significance and summarize the knowledge gained from those experiences.

2.2 Outcome-based learning management

Outcome-based learning management is an educational technique that aims to help students develop their ability to use knowledge, skills, attitudes, and other qualities holistically in work, problem-solving, and everyday situations. It emphasizes education that is relevant to real-life situations, as well as learning for practical application rather than simply accumulating knowledge. The reform of assessment and evaluation concepts to measure learners' achievements based on intended learning outcomes is critical to the approach's effectiveness. This is crucial for all subjects or curricula, with assessment procedures tailored to the teaching methods of each subject or program [21]. The curriculum, teaching, and assessment are all focused on educational outcomes, with explicit objectives and outcome evaluations that include learning outcomes based on constructive alignment across all competency areas. Furthermore, outcomes-based learning requires continuous assessment through a variety of classroom learning management tools [22].

Designing outcome-based educational processes. Outcome-based education (OBE) relies heavily on designing transformative learning experiences for students.

This involves establishing clear goals and ensuring that students achieve positive educational outcomes. The process consists of four stages:

1. Review and examination process: The review and evaluation process involve comparing learning outcomes with employer demands and aligning them with work requirements.
2. Curriculum design process: The curriculum design approach emphasizes fundamental learning objectives over content.
3. Designing learning plans: Adopting a creative approach to align outcomes, evaluation methods, teaching strategies, and student learning activities.
4. Learning outcome assessment process: Comparing expected outcomes to actual student achievements, providing continuous feedback, and ensuring quality assurance to enhance the system's effectiveness.

Organizing outcome-based learning activities. Outcome-based learning activities rely on the triangle of effective learning and teaching, focusing on three critical components to achieve intended learning outcomes.

1. Learning outcomes: The focus is on competency goals that include changes in knowledge, skills, and attitudes. Teaching aims to develop all three qualities, enabling students to apply their new experiences.
2. Assessment method: measuring the effectiveness of instruction and the level of learner achievement in relation to learning outcomes and procedures.
3. Learning activities: Playing an important role in the educational process by implementing the curriculum to achieve goals. The quality of education depends on teaching that fosters learners' development, leading to behavioral changes and enhanced learning experiences.

2.3 Framework of outcome-based learning management

Learning outcomes according to constructive alignment. Constructive alignment in learning outcomes involves a comprehensive macro-level approach to learning management. It expects students to acquire skills that are directly connected to learning outcomes derived from educational activities. This method involves defining outcomes for direct teaching activities in outcome-based learning. Learner development includes aligning relevant learning activities, organizing teaching activities in a sequence, and conducting assessments that result in the desired learning outcomes outlined in the curriculum. It comprises four components: expected learning outcome (ELO), professional course/course learning outcome (PCLO), professional experience (PE), and professional assessment (PA).

Learning management. At the micro-level, learning management is the process of transitioning from an existing state to a relatively permanent new behavior that is influenced by experiences or training. This shift helps teachers acquire confidence in their teaching and facilitates successful knowledge transfer to students. The process consists of four components: learning objectives, learning design, learning activities and practice, and learning evaluation, which are interconnected through reflective thinking.

This model aligns learning outcomes with constructive alignment to assist mechanical engineering students in developing competencies in line with

professional teaching standards. Figure 1 demonstrates how reflective thinking can enhance learning management competencies effectively. The outcomes-based learning management process takes place when the instructor sets clear learning management goals in mechanical engineering, designs learning experiences, provides engineering professional training, and evaluates learning performance by emphasizing reflection at each stage towards the goal, both at macro and micro levels.

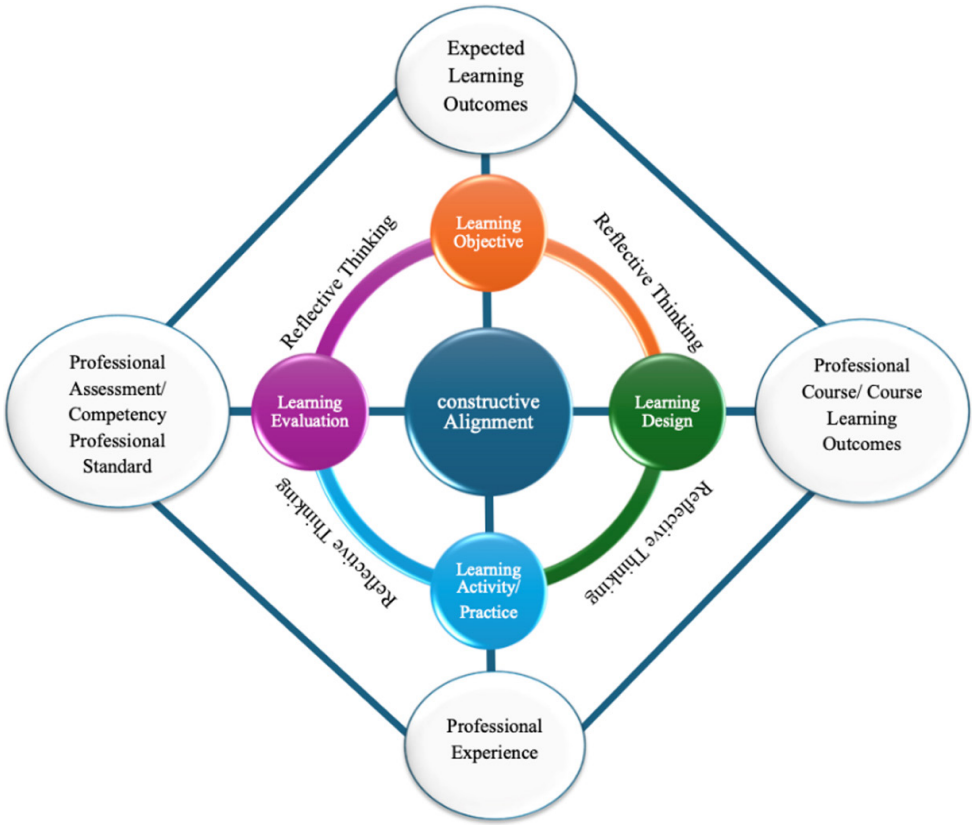


Fig. 1. A conceptual framework for outcome-based learning management

3 METHODOLOGY

3.1 Participants

The population consisted of undergraduate students from Rajamangala University of Technology Thanyaburi's Bachelor of Science in Technical Education program who were enrolled in the course "Learning and Vocational Classroom Management" during the first semester of the 2023 academic year. This study included 89 third-year students from three disciplines who were preparing for teaching practice in educational institutions in the academic year 2024. Through cluster random sampling, the study specifically chose 23 mechanical engineering students.

3.2 Design of the research

This study employed a conceptual framework for an outcome-based learning management design that was experimented with mechanical engineering students

enrolled in the subject "Learning and Vocational Classroom Management" with a study design, as illustrated in Figure 2.

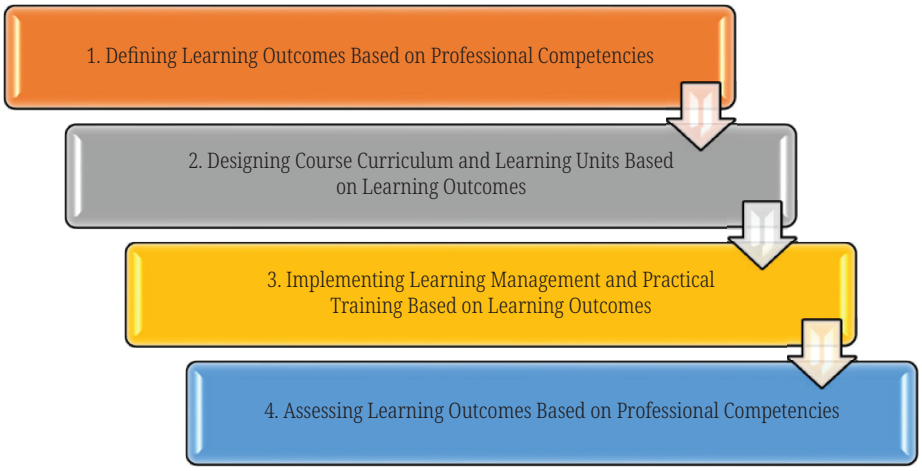


Fig. 2. Research design

This is a semi-experimental study in which students are evaluated using pre- and post-tests. They then reflect on their actions, write lessons from practice, and share their learning with teachers and classmates. Table 1 illustrates that the study process is divided into four parts.

Table 1. Research process

Research Process	Detailed Description
1. Defining Learning Outcomes Based on Professional Competencies.	**1.1.** Review the teaching profession standards. **1.2.** Analyze the Industrial Education curriculum competencies in Mechanical Engineering. **1.3.** Evaluate stakeholder needs.
2. Designing Course Curriculum and Learning Units Based on Learning Outcomes.	**2.1.** Set curriculum objectives. **2.2.** Create a learning management plan that is aligned with the learning outcomes. **2.3.** Design learning activities for each unit. **2.4.** Prepare instructional materials. **2.5.** Develop assessment tools for learning outcomes.
3. Implementing Learning Management and Practical Training Based on Learning Outcomes.	**3.1.** Execute teaching according to the learning plan. **3.2.** Organize practical learning management activities. **3.3.** Practice reflective thinking following learning and training (action-oriented reflection).
4. Assessing Learning Outcomes Based on Professional Competencies.	**4.1.** Conduct pre- and post-learning knowledge assessments. **4.2.** Evaluate students' learning management competencies through practical training. **4.3.** Analyze content for reflective thinking evaluation.

3.3 Assessment instrument

The assessment of learning outcomes for mechanical engineering students in outcome-based learning management is aligned with constructive alignment, and the details of the learning management evaluation tools are provided in Table 2.

Table 2. Learning management evaluation tools

Evaluation Tools	Description of the Evaluation Tool
1. Knowledge test.	The pre- and post-tests are standardized, with four choices for 40 responses. The tests in each section are designed to assess the behavioral aims of the Learning and Vocational Classroom Management subjects, specifically teaching management, integrated learning management, and class management [23].
2. Group Activity Assessment.	A group-working activity evaluation approach is used, which involves assessing trainee attendance while they follow the activity sheet presented to them. The tool is used for observation and generates five scores. The type of response level is a Likert 5 scale (very good–good–average–poor–extremely poor), an interval in percents equivalent to their view of what is "very good", "good", and so on [24].
3. Reflection Assessment.	Reflective learning uses an experience-writing process to plan learning activities in each subject based on a qualitative content analysis. Based on ten teaching management points, the following are: introduction to the lesson, personality, and tone of the instructor, encouraging student participation in teaching and learning activities, self-confidence, accuracy in the content taught, appropriateness and diversity of teaching materials, student participation in teaching and learning activities, diversity of teaching and learning activities, measurement and evaluation of learning outcomes [25].

To ensure the quality of the instrument used in this evaluation, experts conducted a content validity review, resulting in item objective congruence (IOC) values ranging from 0.67 to 1.00 [26]. The instrument underwent a trial phase and was assessed for reliability using Cronbach's alpha coefficient, which produced a highly reliable result of 0.93 [27].

3.4 Data collection

Organizing outcome-based learning activities for mechanical engineering students. A newly developed learning approach was implemented to structure outcome-based learning activities for mechanical engineering students taking the course "Learning and Vocational Classroom Management" in the first semester of the academic year 2023. This approach included establishing learning objectives, incorporating active learning methodologies, and evaluating students through reflective thinking. The educational content covered instructional models, teaching management, integrated learning management, learning management plans, and classroom management.

Using constructive alignment to assess outcome-based learning for mechanical engineering students

1. Students took a pre-learning test using a competency assessment in the learning management system. There were four possible responses, totaling 40 items.
2. The course, which lasted 15 weeks and required five hours per week (totaling 75 hours), emphasized outcome-focused learning through constructive alignment. Students collaborated in groups on practical learning management activities, and their proficiency in learning management was assessed through collaborative practical teaching activities.
3. Post-activity involvement was used to measure reflective thinking. Students wrote comments on Google Docs and shared their ideas with teachers and peers on each of the ten teaching management topics.
4. After completing the course, a post-learning competency evaluation in learning management was conducted.

3.5 Data analysis

1. After completing teaching and professional experience training, qualitative data were evaluated using content analysis to assess reflective thinking outcomes.
2. The quantitative data were evaluated using basic statistical values such as percentages, means, and standard deviations.
3. Statistical analysis of learning efficiency using the t-test [28].
4. The normalized gain method was used to assess learning progress [29]. The interpretation of the normalized gain is presented in Table 3.

$$g = \frac{[\%posttest - \%pretest]}{[100 - \%pretest]}$$

Table 3. Criteria for assessing learning progress using normalized gain values

Normalized Gain	Mean
$g \geq 0.7$	High gain
$0.3 \leq g < 0.7$	Medium gain
$0.0 \leq g < 0.3$	Low gain

4 RESULTS

The evaluation of learning success and reflective thinking is critical for enhancing student competencies in outcome-based learning management through constructive alignment.

4.1 Assessment of learning progress in outcome-based learning management according to constructive alignment

Comparison of the learning achievement results of mechanical engineering students in the subject "Learning and Vocational Classroom Management". A comparison of the learning achievement results of mechanical engineering students in the subject "Learning and Vocational Classroom Management" was conducted.

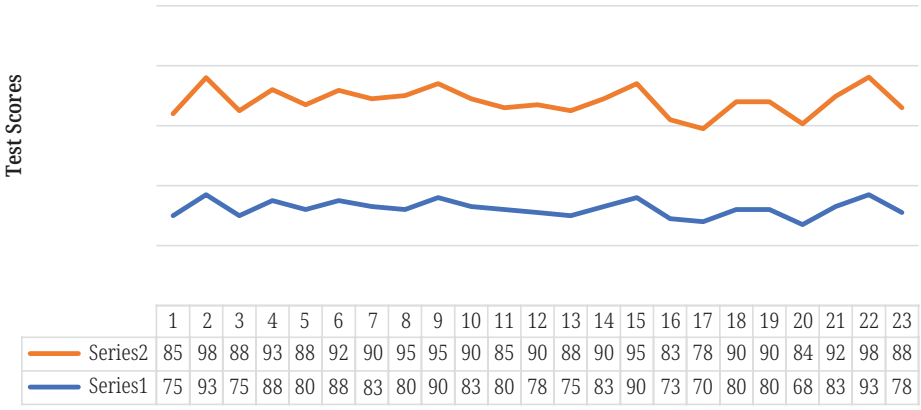
Table 4. Comparison of mechanical engineering students' learning achievement results before and after the course

Exam Results	N	Mean	t	P
Pre-exam	23	81	11.99	0.00
Post exam	23	90		

Note: Significant at the 0.05 level.

Table 4 shows a significant change in scores before and after the course, indicating an enhancement in learning achievement.

The investigation involved comparing individual learning outcomes, as illustrated in Figure 3, which displays the range of scores before and after the training.



	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Series2	85	98	88	93	88	92	90	95	95	90	85	90	88	90	95	83	78	90	90	84	92	98	88
Series1	75	93	75	88	80	88	83	80	90	83	80	78	75	83	90	73	70	80	80	68	83	93	78

Fig. 3. Range of scores before and after the course

Figure 3 depicts the range of scores before and after the course. Among the 23 students, the average pre-learning test score was 81%, while the average post-learning test score was 90%. The score levels differed significantly, but they tended to be parallel.

Assessment with normalized gain. Students' learning progress in the same course was analyzed using the normalized gain method.

Table 5. Learning progression of mechanical engineering students in the subject "Learning and vocational classroom management"

Exam Results	N	Mean	Normalized Gain
Pre-exam	23	81	0.45
Post exam	23	90	

Table 5, which summarizes this data, indicates that the average score increased from 81% to 90%. The normalized gain score of 0.45 falls within the medium gain range.

Evaluation utilizing the normalized gain value, which displays the information for all 23 individual students, shows that each student has a normalized gain value as depicted in Figure 4.

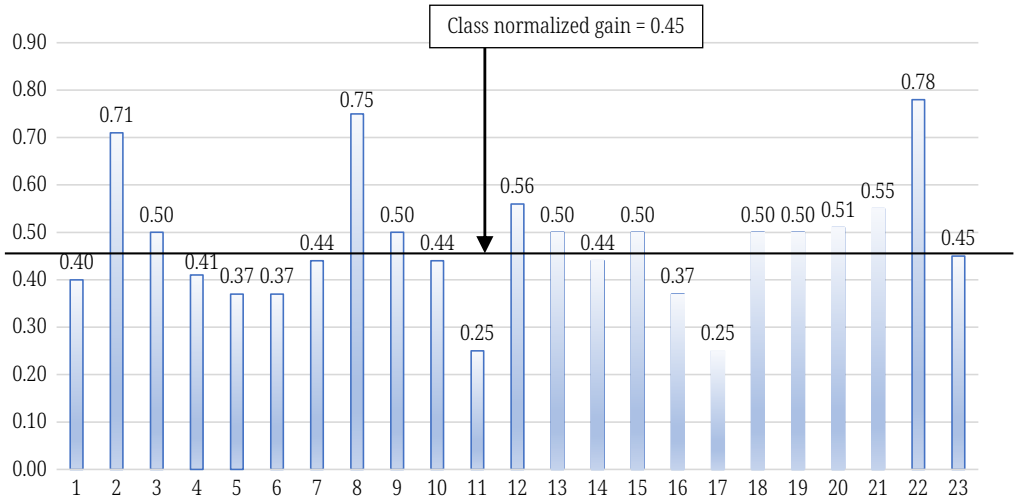


Fig. 4. Individual normalized gain scores in learning

Further analysis utilizing individual learning progress charts, as shown in Figure 4, divides the students' learning progress into high, medium, and low gains. This study reveals that two students with low gain scores had lower pre- and post-learning test scores, which influenced their normalized gain scores.

4.2 Assessment of competencies in outcome-based learning management

An evaluation of mechanical engineering students' performance in learning management was conducted using outcomes-based learning as the foundation. This was achieved by assessing activities assigned to practitioners, observing the learning management behavior of students working in groups, and evaluating the summary, as illustrated in Figure 5.

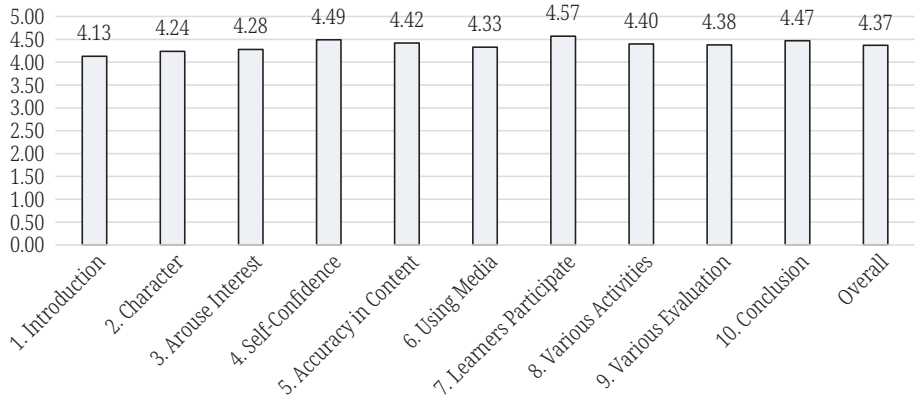


Fig. 5. Assessment results of competencies in learning management of mechanical engineering students

Figure 5 illustrates the assessment of mechanical engineering students' competencies in outcome-based learning management using constructive alignment, revealing a high overall competency level (mean = 4.37). Upon evaluating the individual components, it was found that 'Learners' Participation' achieved the highest score (mean = 4.57), followed by 'Self-confidence,' 'Conclusion,' and 'Accuracy in Content' with means of 4.49, 4.47, and 4.42. The components with the lowest scores were 'Arouse Interest,' 'Character,' and 'Introduction,' scoring 4.28, 4.24, and 4.13, respectively.

4.3 Assessment of reflective thinking in outcome-based learning management

The subject "Learning and Vocational Classroom Management" assessed mechanical engineering students' reflective thinking by having them write lesson plans for practical sessions in which they acted as teachers. These 50-minute microteaching sessions were designed to imitate real-world classroom scenarios. Reflective questions posed after these educational exercises allowed students to connect theoretical principles and course content to real-world applications. They also highlighted their strengths and areas for improvement, resulting in increased confidence in their teaching abilities. Table 6 shows the outcomes of this assessment.

Table 6. Assessment results from reflective thinking of mechanical engineering students after learning in the subject "Learning and Vocational Classroom Management"

Reflective Point	Summary from Reflective Thinking
1. Introduction to the Lesson	• Students noted that establishing the lesson's topic helps them connect with the content. They recommended employing a variety of activities for the introduction, such as questioning to promote thought, showing a short video to capture attention, and administering brief tests to assess foundational understanding. This strategy better connects the activities with the students' needs. They also emphasized the importance of class introductions being concise and tailored to the behavior of today's students, as well as not taking up too much time.
2. Personality and Tone of the Instructor	• Students stated that clear, fluent, and sufficiently loud speech builds confidence in the teacher. Changing the tone, from high to low, can also spark curiosity. A smooth and pleasant voice was found to promote a more relaxed learning environment. Students also stressed the need for teachers to dress appropriately and politely in accordance with professional teaching standards, such as avoiding overly casual attire.
3. Encouraging Student Participation in Teaching and Learning Activities	• Students believe that engaging teaching strategies, such as asking for individual student responses, addressing students by name for answers, or encouraging voluntary participation, can stimulate their curiosity. Furthermore, involving students in group projects, incorporating physical activity, allowing presentations in front of the class, and encouraging regular participation in learning activities are viewed as ways to enhance learning and diversify the classroom environment.
4. Self-Confidence	• Students believe that a teacher's confidence, combined with a lack of shyness or hesitation and an appropriate level of enthusiasm, greatly increases their interest in teaching and learning. This perception is based on the notion that such teachers are well-prepared, have carefully planned their lessons, and are knowledgeable about the subject area. In contrast, teachers who lack confidence or enthusiasm may diminish student interest and engagement.
5. Accuracy in the Content Taught	• Students believe that having a thorough understanding of the subject allows teachers to effectively explain concepts and guide students through exercises. This knowledge base is closely related to self-confidence; teachers who are accurate and knowledgeable about their subject matter tend to be more confident in their teaching abilities. They can explain topics, provide informative examples, demonstrate techniques, and offer personalized guidance. Additionally, students admire teachers who prepare well in advance, including rehearsing prior to actual teaching sessions, to ensure a confident delivery and adherence to the scheduled activities in the lesson plan.
6. Appropriateness and Diversity of Teaching Materials Used	• Students believe that the media used for teaching should be topic-appropriate, diverse, and varied. Some subjects, for example, may be better taught with real-life objects, while others may benefit from simulations or graphics. It is recommended that presentations contain a moderate amount of text, with font sizes large enough to be easily readable. Practical education should combine real-life media and provide students with hands-on practice opportunities. Furthermore, students value the incorporation of technology into instruction, recommending the use of interactive tools such as Quizizz, Nearpod, Kahoot, or digital exercises as a modern alternative to traditional paper-based methods.
7. Student Participation in Teaching and Learning Activities	• Students agree that including both individual and group activities in the learning process significantly increases enjoyment. They also believe that introducing elements of group collaboration or competition into these activities encourages greater engagement among peers in class.
8. Diversity of Teaching and Learning Activities	• Students assert that careful preparation by teacher's results in a variety of engaging activities throughout the class, from the introduction to the end of the lesson. They believe that prioritizing activities that allow all students to express themselves and participate in practical tasks leads to more productive and enjoyable learning experiences. This approach is viewed as critical to encouraging active student participation in both teaching and learning activities.
9. Measurement and Evaluation of Learning Outcomes	• Students believe teachers should use a variety of methods to analyze and evaluate learning outcomes, such as questioning, practical activities, end-of-lesson assessments, and behavioral observations. They emphasize that these assessment methods should be aligned with the established learning objectives and the content presented. Furthermore, students advocate for the use of technology in assessments, citing its potential to improve ease and efficiency.
10. Summarization of Learning Outcomes	• Students believe that summarizing lesson topics at the end of each session significantly improves their understanding. They advocate for summaries that are succinct, direct, yet comprehensive, and easy to understand. Furthermore, they believe that student participation in writing these summaries serves as an effective self-review tool, reinforcing their understanding of the content.

5 DISCUSSION

5.1 Assessment of learning progress in outcome-based learning management based on pre- and post-learning tests

A comparison of mechanical engineering students' learning outcomes before and after the course demonstrated significant score increases. The examination revealed a medium gain level (0.45) in learning development, with the majority (18 out of 23 students) achieving medium gains, which are regarded as substantial under the specified criteria. The teachers prepared behavioral objectives for the instructional model, teaching management, integrated learning management, learning management plans, and classroom management, and organized a variety of active learning activities to encourage and advise students to develop a complete learning process that results in improved learning outcomes. This improvement coincides with the requirement for more efficient and effective learning outcomes, validating the findings of Khuana, who found a statistically significant difference at the .05 level between post-learning and pre-learning achievement scores [30]. Reported score increases following the program indicate an immediate positive impact on participants' knowledge [31]. Problem-solving and reflection are some of the strategies and methods utilized to help students improve their learning outcomes [32]. Effective active learning management maximizes learning opportunities through collaborative activities [33]. The evaluation of learning management capabilities, particularly when developing learning plans, is an important link between learning outcomes, assessment methodologies, and student teaching activities.

5.2 Assessment of competency in outcome-based learning management

The overall competency in outcome-based learning management was found to be high through constructive alignment. Notably, the element 'Learners Participating' had the highest average score. This demonstrates students' strong interest in learning management-related subjects, especially those studying in the vocational and industrial teaching sectors. Observations from the evaluation of student performance resulted in learning outcomes. Individual performance evaluations that included collaborative work in groups set by the instructor led to the expression of various practical behaviors in all students.

Mechanical engineering students demonstrated effective application of knowledge and skills in tasks such as creating lesson plans and devising practical teaching activities using vocational methodologies. They covered subjects such as instructional models, teaching management, integrated learning management, learning management plans, and classroom management [34]. Student performance assessment is a developmental evaluation that teachers must measure and evaluate throughout the learning process, from learning management to task presentation. Learning the fundamentals of management will be successful with a variety of approaches. This aligns with the 21st-century competencies for teachers, which include curriculum administration, learner development, classroom management, and research. The students showed a strong interest in and active participation in these activities, consistent with the findings of [35]. Quality learning strategies benefit students by allowing them to play an active role in the learning process

and encouraging learning. Students can set their own learning goals and complete tasks or activities during the learning process to foster critical thinking and problem-solving. Outcome-based learning management will expand into a wider range of courses in the future, potentially becoming a powerful tool for vocational education teaching and learning. This will enable students to develop the skills and knowledge necessary to succeed in their careers [36]. To create an effective professional student learning plan, teachers must be able to plan their classes, prepare them to follow the curriculum, and organize their learning activities in the correct order of stages [37]. Developing teachers with appropriate knowledge and skills requires effective lesson planning, including a teaching plan that aligns with the curriculum and reflects a professional approach to teaching [38]. The collaborative learning design based on the department will influence student performance [39]. Standardized performance evaluation tools for teacher career development enable teachers to connect quality theory and practice. The examination demonstrated students' skills in designing lesson plans, organizing teaching activities, and engaging in activities that match learners' abilities and interests, thereby enhancing their professional competencies.

5.3 Assessment of reflective thinking in outcome-based learning management

The evaluation results are reflected in the subject of "Learning and Vocational Classroom Management," which encompasses learning management strategies and learning exchanges. Students achieve good learning outcomes based on principles. Lessons are taught in real-life scenarios, which boosts students' confidence in their teaching abilities. The evaluation process, based on constructive alignment, required students to create learning management strategies and simulate classroom settings. Key reflective points covered various aspects such as lesson introduction, teacher's personality and tone, student participation, teacher's self-confidence, content accuracy, and the use of appropriate and diverse teaching aids. Additionally, it includes engaging learning activities, diverse teaching methodologies, assessment and evaluation techniques, and lesson summarization. These reflection activities help students apply theoretical knowledge in practical situations, evaluate their strengths and areas for improvement, and gain confidence in their teaching abilities. Such reflection aligns with the findings, suggesting that reflective thinking is valuable and beneficial for those seeking to enhance their teaching and learning. It serves as a guide for developing performance reflection, managing student learning through problem-solving, and applying professional experience to foster innovation in teaching management [40]–[41]. It emphasizes its significance in professional conduct, addressing workplace challenges, and developing problem-solving abilities. Students' reflections focus on the teacher's role, highlighting the importance of engaging in activities and effective communication [42]. Reflecting and employing creativity enables students to reflect, review, and uncover reasons and results by providing them with an outlet for their learning experiences through writing a summary. This positively impacts learning effectiveness [43]. This approach is supported by emphasizing the role of reflective learning in adapting teaching methods and promoting integrative activities for lifelong learning [44]. Additionally, learning in small groups allows students to reflect on ideas. Microlearning goes beyond delivering learning information in small, easily digestible bits [45]. Overall, reflective thinking in outcome-focused learning management promotes introspection and a greater

awareness of the impact of one's thoughts, feelings, attitudes, and beliefs on their actions, resulting in a well-rounded learning experience.

6 CONCLUSION

By developing competencies for teaching professional mechanical engineering students through student reflection, learning can be planned around learning outcomes under constructive alignment. According to research findings: 1) Many students make average progress in their courses. Three students improved significantly in their learning, whereas two made minimal progress. Considering the test results from the pre- and post-study periods, the distribution of scores generally follows the same trend. 2) The majority of students are proficient in learning management. The competency in which learners participate has the highest average, followed by self-confidence, conclusion, and content accuracy. Introduction has the lowest evaluation outcomes when compared to the other competency areas. 3) Reflections on students' learning management after microteaching practice in 10 categories revealed the following results: (1) When introducing the lesson, a variety of methods should be used to spark the students' interest. (2) The teacher's personality and tone should be distinct, with both high and low tones, while maintaining a pleasant tone of voice. (3) To encourage student participation in teaching and learning activities, students should participate in group activities and learn together. (4) Self-confidence: The teacher should be energetic and able to communicate with students without becoming nervous. (5) To ensure accuracy in the subject matter, teachers should plan their lessons ahead of time. (6) Appropriate and diverse teaching materials, such as teacher-used simulation media, real media, visuals, and technological media, are all suitable for today's students. (7) Student participation in teaching and learning activities should be both individual and group-based. (8) There should be a diversity of teaching and learning activities; each student should have the opportunity to express their thoughts and practice. (9) Learning outcomes should be measured and evaluated using a variety of methods, aligning with the objectives and course content. (10) Learning outcomes should be measured and evaluated by the teacher at the end of each class, and having students participate in summarizing the instructional topic will help them understand it better.

7 RECOMMENDATIONS

The conclusion effectively outlines the key aspects of implementing effective teaching techniques for mechanical engineering students, emphasizing the significance of adhering to current educational standards set by the Thai Teachers Council. It underscores the importance of using innovative teaching strategies such as constructivism, critical reflection, and transformation approaches, which prioritize learner-centered interactions. The outcome-based learning strategy, aligned with constructive alignment, is portrayed as a systematic approach for integrating competencies and standards into professional teaching. The adoption of constructive alignment as a framework is recognized for its contribution to fostering diverse learning concepts and enhancing teaching abilities.

The limitation of this study is that the students' learning management is simulated in the classroom under the subject "Learning and Vocational Classroom Management," where the environment and atmosphere in the study are only simulated situations.

Therefore, when students practice in schools, they need to apply their experience to real-life situations. Further research studies should track students' teaching experiences and assess their teaching skills in real-world situations to evaluate the sustainability of knowledge gained from their university studies.

Furthermore, the conclusion underscores the significance of reflective thinking in accelerating learning, promoting introspection, and developing cognitive processes for real-world application. The role of teachers in encouraging reflective questioning and critical thinking is also highlighted, emphasizing its impact on lifelong learning.

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9 AUTHORS

Akkarat Poolkrajang is an Associate Professor in the Department of Technical Education, Faculty of Technical Education at Rajamangala University of Technology Thanyaburi (RMUTT) in Pathum Thani, Thailand. He received his BSc in Technical Education. (BSTechEd) in Mechanical Engineering from King Mongkuts University of Technology North Bangkok (KMUTNB), an MSc in Technical Education (MSTechEd) in Mechanical Technology from KMUTNB, and a Doctorate of Technical Education (DTechEd) in Curriculum Research and Development from KMUTNB. He specializes in mechanical education, vocational education, and competence development (E-mail: akkarat_p@rmutt.ac.th; ORCID: https://orcid.org/0000-0001-7739-320X).

Rinradee Papanai is an assistant professor in the Department of Technical Education, Faculty of Technical Education at Rajamangala University of Technology Thanyaburi (RMUTT) in Pathum Thani, Thailand. She received her Bachelor of Education (B.Ed.) in General Science from Phranakhon Rajabhat University, her Master of Education (M.Ed.) in Supervision and Curriculum Development from Chulalongkorn University, and her Doctor of Philosophy (Ph.D.) in Curriculum and Instruction from Chulalongkorn University. She specializes in curriculum development, teaching and learning, vocational education, and educational research (E-mail: rinradee_p@rmutt.ac.th; ORCID: https://orcid.org/0000-0002-1910-7444).