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Lecture-Based and Project-Based Approaches to Instruction, Classroom Learning Environment, and Deep Learning

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Abstract: Institutions of higher education generally employ both lecture-based and project-based approaches to instruction. This study aims to investigate which aspects of lectures and project-based instructional environments contribute to "deep" and "surface" approaches to student learning. We collected and compared survey data from undergraduate students taking a civil engineering course in which they were assigned to a section taught with lecture-based instruction (n = 181) or with project-based instruction (n = 142). Data analysis was performed after controlling for the effects of the motivational goal orientations of students. A positive correlation can be found between deep learning and higher levels of investigative culture and student involvement in the project-based classroom. Additionally, we found that higher levels of task orientation in the project-based classroom had an inverse correlation with a "surface approach". We discussed the value of an investigative and participatory learning atmosphere for student approach to learning and its curricular implications for the design of project-based and lecture-based instruction.

Keywords: *Approaches to learning, classroom learning environment, deep learning, project-based learning.*

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Introduction

Changes in society and rapid globalization have shifted the workforce. With frequent disruption and constant changes in society, along with the introduction of new innovations, jobs require more than just having knowledge but rather how to use knowledge. Therefore, the goal of education is to shift towards applying higher-order thinking skills rather than memorizing (Hamzah et al., 2022). To reach this goal, lecturers need to choose the best strategy to enhance education and find the best teaching methods. The teaching strategy needs to change from delivering knowledge to active learning that is student-centered (Ali, 2019). Several teaching approaches including project-focused learning, problem-focused learning, discovery learning, case-focused learning, and inquiry-focused learning (Singh et al., 2020) will promote better learning through analyzing rather than memorizing. It is also emphasized that having knowledge is less important than being able to apply knowledge (Baeten et al., 2013).

Deep approach learning refers to students' capacity to acquire a more profound comprehension of the subject matter and utilize the concepts to expand their understanding. On the contrary, the surface approach or shallow approach to the learning process is only memorizing data and materials, but this learning leads students to lack the ability to apply or generate those materials further (Biggs, 1989). Undoubtedly, the primary objective of effective teaching is to persuade learners to be involved in learning rather than relying on the surface approach method (Biggs, 1999). Approach to learning is a good tool used to explain the process of the way students learn, clarify further how the learning process can be improved, and help teachers improve teaching (Biggs et al., 2001). A deep-learning approach develops higher cognitive levels and logical reasoning compared to a surface-learning approach. A deep-learning approach promotes abilities to explain, hypothesize, argue and reflect theories. Students who employ deep learning methods demonstrate a deeper understanding of complex concepts, while students who utilize a surface-learning approach, lack analytical skills and merely rely on memorization of the material. While surface approach learning promotes lower reasoning ability, students can only memorize and explain the concept with a very broad understanding, and these students cannot expand the concept further (Biggs & Tang, 2011). Therefore, different learning processes result in different outcomes (Biggs, 1989; Entwistle, 1991, 2000; Trigwell & Prosser, 1991). In the

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21st century, a deep approach to learning has been widely accepted. Numerous efforts have been made to foster a deep-learning approach through constructivist teaching, which emphasizes learners' active construction of self-knowledge. Studies show that in higher education, various hypotheses of students' learning approach lean towards a deep-learning approach (Asikainen & Gijbels, 2017).

The classroom serves as the primary setting where significant activities relating to learning and teaching happen. Therefore, the learning atmosphere within the classroom significantly impacts the learning and instructional experience for both educators and learners. It encompasses a wide range of social, psychological and physical factors that affect teaching (Liu & Fraser, 2013). Classroom environment assessments are used by researchers to form criteria for education programs and innovation evaluation. The perceptions of the classroom learning environment are classified into 7 dimensions which consist of; (a) Student cohesiveness: students are closely related to peers in class. (b) Teacher support: teachers support and consider student well-being. (c) Investigation: exploring and experimenting approaches are applied by students. (d) Involvement: student's interactions, discussions and enjoyment in class. (e) Task orientation: Student's effort on an assigned task (f) Collaboration: teamwork of students and their peers in class. (g) Equity: equal treatment of students in the classroom (Fraser et al., 1996). There are several attempts have been undertaken to observe the connection between psychological factors in the classroom and approaches to learning. A study by (Dart et al., 1999) examines the correlation between the secondary perception of learners regarding the classroom learning atmosphere and their learning approaches. In this research, a significant association has been found between a deep-learning approach and the perception of a highly personalized classroom environment that fosters active involvement in the process of learning and enables students to develop their analytical skills through various learning activities. According to a study conducted by Baeten et al. (2016), students applying a deep-learning demonstrate the ability to construct knowledge and engage in cooperative learning. On the other hand, the surface or shallow learning approach is differentiated by a preference for teacher instruction and passive learning. In their study, Pires et al. (2020) examine how a collaborative-focused learning atmosphere, specifically through teams, impacts medical students' approaches to learning. The findings reveal that factors such as strong group commitment, case discussion participation, teachers' challenges, and opportunities for patient visits were perceived as enhancing a deep-learning approach. Conversely, an overload of course activities was identified as a hindrance to adopting a deep approach to learning.

Moreover, research papers conducted previously have involved the motivation of students toward learning. These studies found that motivational orientation is a concept that falls within the affective domain. Mastery goal structures measure the student's perception of the instructor's emphasis on self-improvement, reward efforts and value mastery of learning while performance goal structures measure the student's perception of the instructor's emphasis on social comparison and define focus on higher grades in a classroom learning environment (Lerdpornkulrat et al., 2018). In their study, Koul et al. (2012) investigated the interconnection between individuals' motivational achievement goal orientations and the learning environments found in biology and physics classrooms. The outcomes of the study illustrate motivations of students are connected to disparities in their views of the classroom learning atmosphere. The study outcome in this article leads to further comprehension of several factors related to learning outcomes, in which higher-order thinking is one of the outcomes led by a deep-learning approach, and correlated with constructivist teaching. Similar research has been conducted in various geographical locations exploring topics parallel to the studies mentioned earlier. However, this study was conducted in the context of the Thai tertiary education level. This study focuses on three key factors within Thai tertiary education: studying environment perceptions, learning approaches, and motivational goal orientation. Additionally, the study addresses the instructional gap related to teaching methods, specifically comparing lecture-based and project-based approaches for their effectiveness. Therefore, the objective of this article is to investigate predictors of "deep" and "surface" learning approaches. This research investigates the questions as follows:

- What is the correlation between perceptions of classroom learning amongst students, approaches to learning, and motivational goal orientation?

- Beyond the impact of motivational goal orientations, which aspects of lecture and project-based instructional environments contribute to "deep" and "surface" learning approaches?

Research Framework

To understand which dimensions of the classroom learning environment and motivational goal orientation influence approaches to learning. The research framework is drawn from perceptions of the classroom learning environment and motivational goal orientation that contribute to the student approaches to learning. Differences in lecture and project-based instructional environments were used in this study.

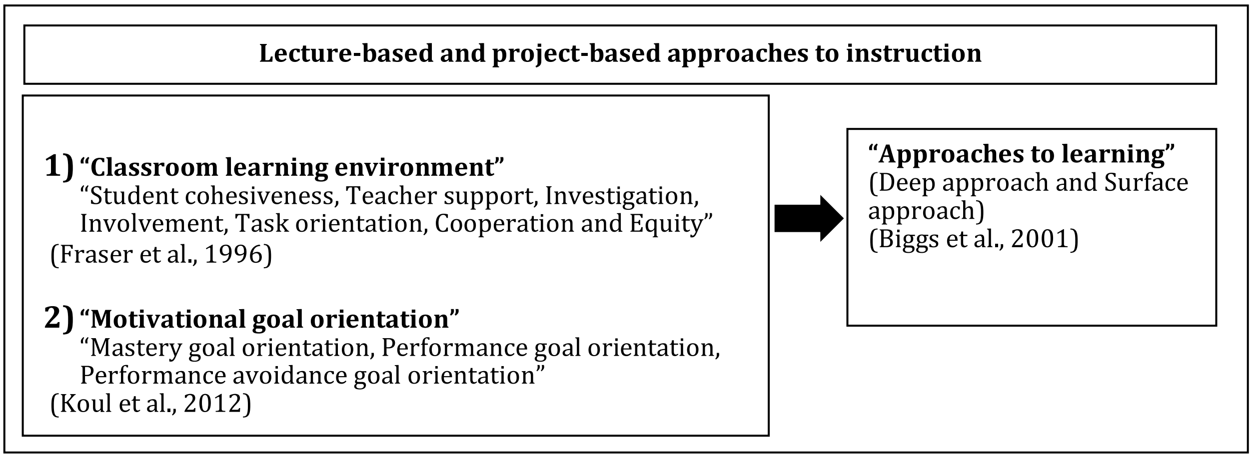

Figure 1. Research Framework

Methodology

This part provides details of the research methods that were used in this study. These include (a) a description of different instructional used in this study (b) a description of participants in the study and data collection procedure, (c) the instruments used for assessing the variables, and (d) data analysis.

Instructional methodologies

There are two instructional methods used in this study which are lecture-based and project-based learning. In lecture-based classes, the teacher-centered method of teaching is applied to the classroom. It means teachers will plan and provide all information to students through either digital or paper presentations and they will have a quiz at the end of the class to test students' memory. In project-based classes, the teacher played the role of an advisor to each student group. Students were divided into a group of 5-6 people. Activities started with the teacher assigning the driving question that encouraged students to solve problems and understand major concepts, principles and practices. Students were then allowed to explore the open key questions and brainstorm to share ideas with friends and develop the first draft solution to the driving questions. The solution was then discussed among the team and also with the teacher. They continued to search for information through technological tools such as websites, videos, and online databases. This process was interactive until the idea was ready to be made into a prototype. Finally, students presented the design concepts, procedures and planning of their work to other students and teachers.

Participants

Our study involves engineering undergraduate students at a higher education institution in Thailand. We collected survey data by convenience sampling technique from enrolled students who are taking the same class in the civil engineering program. The class is divided into two sections with different instructional methodologies, which are lecture-focused learning and project-focused learning. 340 students enrolled in the civil engineering program were invited to be part of this study. More than 95% of the survey responses were completed (N = 323, Male = 65%; Female = 35%). The proportions of males and females in this study closely represented the proportion of Thailand engineering program students by Office of the Higher Education Commission of Thailand which is 68% and 32% respectively. Fifty-six percent of respondents enrolled in the class that used lectured-based learning and the rest were in project-based learning.

Instruments

The survey questionnaire was used as a research tool for this study. The survey consisted of various items written in Thai, which aimed to assess demographic information, classroom learning environments, motivational achievement goal orientations, and approaches to learning. The original survey questions from previous research were written in English which is detailed below. To ensure the validity of the survey items, we utilized a translation/back-translation research technique, following the approach outlined by Behling and Law (2000). Two bilingual individuals proficient in both Thai and English languages conducted the two-way translations of the questionnaires, thereby ensuring their accuracy and reliability. Additionally, the translated version of the survey questionnaires was tested with a sample of 30 students to ensure clarity, cultural relevancy and correct interpretation before proceeding with the data collection process.

Demographic information: The questions in this section asked the participants about their general details including grade point average (GPA) and gender. Regarding gender coded 0 is referring to males and 1 is referring to females.

"Classroom learning environment": The survey about the classroom learning atmosphere perceptions among students was adapted from a questionnaire called "WIHIC (What Is Happening In This Class?)" developed by Fraser et al. (1996). Eight items for the student cohesion factor (e.g. "I am friendly to other students in this class"), eight items for teacher support factor (e.g. "The teacher helps me when I have trouble with the work"), eight items for investigation factor (e.g. "I do experiments to test my ideas in this class"), eight items for involvement factor (e.g. "I give my opinions during discussions in this class"), eight items for task orientation factor (e.g. "I do as much as I set out to do in this class"), eight items for cooperation factor (e.g. "I work with other students in this class"), and eight items for equity factor (e.g. "I get the same amount of encouragement from the teacher as other students do in this class"). To assess classroom learning environments, a Likert scale has been used where the scale (1) indicates strongly disagree and (5) indicates strongly agree.

"Motivational goal orientation": For the motivational achievement goal orientation items, a modified version of a previously validated motivational goal orientation survey has been distributed to high school students in Thailand (Koul et al., 2012). The survey aims to assess six items for the mastery goal orientation factor (e.g. "I feel satisfied when I learn new things in this class"), six items for the performance approach goal orientation factor (e.g. "I feel good when I perform better than other students in this class"), and six items for the performance-avoidance goal orientation factor (e.g. "In this class, I don't want my teacher to evaluate me because she may find me incapable") A Likert scale was applied to assess motivational achievement goal orientations where (1) indicates strongly disagree and (5) indicates strongly agree.

"Approaches to learning": The measurement of students' learning approaches was based on adapted items from the updated questionnaire called "Two-factor Study Process (R-SPQ-2F)" which was created by Biggs et al. (2001). This survey was composed to reflect deep and surface learning. Ten items for the deep approach factor (e.g. "I find that at times studying in this class gives me a feeling of deep personal satisfaction"), and ten items for the surface approach factor (e.g. "In this class, I find I can get by in most assessments by memorising key sections rather than trying to understand them.") were assessed using a Likert scale where (1) indicates strongly disagree and (5) indicates strongly agree.

The variables' structure related to motivational goal orientation, the classroom learning environment, and the learning approach was verified by using Confirmatory factor analysis (CFA). The adequacy of the model was evaluated by employing the Standardized Root Mean Square Residual (SRMR) and Comparative Fit Index (CFI). An acceptable adequate was determined by a CFI value above .95 and an SRMR value below .08, as suggested by Hooper et al. (2008). For reliability of the motivational goal orientation measurement, classroom learning environment and approach to learning, the typical measure of scale reliability - Cronbach's alpha, has been used. The measurement was calculated separately for each sub-scale. A Cronbach's alpha value exceeding .70 indicates the reliability of the modified questionnaire. (Taber, 2018).

Regarding the classroom learning environment perception, the CFA model demonstrates the outcomes of CFI = .99, RMSEA = .05, and SRMR = .02. The Cronbach's alpha coefficient for these seven constructs were .79, .93, .86, .88, .83, .89, and .92 respectively. Additionally, the Composite Reliability for these seven constructs was as follows: .90, .94, .90, .90, .87, .92, and .93, respectively. For motivational goal orientation, the CFA model shows the outcome of CFI = .95, RMSEA = .09, and SRMR = .05. The Cronbach's alpha coefficient for these three constructs were .84, .90 and .90 respectively. Furthermore, the composite reliability for these three constructs was .89, .92, and .93 respectively. For approaches to learning, the CFA model shows the outcome of CFI = 1.00, RMSEA = .00, and SRMR = .00. The Cronbach's alpha coefficient for these two constructs were .84 and .91 respectively. Turning to the composite reliability for these two constructs, the result was .89 and .93 respectively. Based on the results of the CFA model, Cronbach's alpha coefficient, and Composite reliability, the survey instrument demonstrates suitability for further research purposes.

Analysis

Three statistical analyses are being employed in this research including simple correlation, t-test and multiple regression. Initially, assessing data normality involves the evaluation of skewness and kurtosis metrics. It is recommended that these metrics have magnitudes ±3.0 for skewness and ±10.0 for kurtosis (Kline, 2011). In this study, the analysis of skewness and kurtosis values for the variables revealed that skewness ranged from -.928 to .326, and kurtosis ranged from -.705 to .991, all falling within the suggested thresholds. Consequently, it can be concluded that each variable exhibited a normal distribution. To observe the correlation between classroom learning atmosphere perception among learners, motivational goal orientation, and their learning approaches, a simple correlation analysis was employed. This was performed by Pearson correlation. The result of a correlation analysis is a correlation coefficient which is a single number ranging from -1 to +1 that demonstrates a linear correlation between two quantitative variables. A higher value results in a stronger correlation whereas a value closer to zero shows no correlation. Negative numbers represent inverse correlation which means opposite side effects (Gogtay & Thatte, 2017). Each indicator of the classroom learning atmosphere perceptions among students, motivational goal orientation, and students' learning approaches was calculated by using means and standard deviation. A t-test was used to examine classroom environment differences based on teaching methods in the dimensions of the classroom learning atmosphere perceptions among students, motivational goal orientation, and students' learning approach. Predictors of "deep" and "surface" learning were analysed by using Multiple regression analysis. The Variance Inflation Factor (VIF) was employed to assess the absence of multicollinearity among the independent variables within the regression model. It is suggested that when the VIF value surpasses 10, it signifies weakly estimated regression coefficients due to the presence of multicollinearity (Shrestha, 2020). In the present investigation, the VIF values ranged between 1.626 and 2.682. As a result, it can be inferred that each variable is suitable for the analysis. Data analysis in this study was performed using SPSS Statistics 21.0

Table 1. Measurement Scales and Reliability Estimates (n = 323)

Scale	Source	# of items	Alpha
Perceptions of classroom learning environment	Fraser et al. (1996)		
• SC		8	.79
• TS		8	.93
• IVT		8	.86
• IVM		8	.88
• TO		8	.83
• CO		8	.89
• EQ		8	.92
Motivational goal orientation	Koul et al. (2012)		
• MGO		6	.84
• PGO		6	.90
• AGO		6	.90
Approaches to learning	Biggs et al. (2001)		
• DA		10	.84
• SA		10	.91

Note. SC = Student cohesiveness; TS = Teacher support; IVT = Investigation; IVM = Involvement; TO = Task orientation; CO = Cooperation; EQ = Equity; MGO = Mastery goal orientation; PGO = Performance approach goal orientation; AGO = Performance avoidance goal orientation; DA = Deep approach to learning; SA = Surface approach to learning.

Results

Based on Pearson correlation ecoefficiency (Table 2) the connection among deep learning, motivational goal orientations, and classroom learning environment perceptions was significantly positive. A strong association ($p < .01$) was detected between deep learning and mastery goal orientation ($r = .598$). A strong relationship was also observed between deep learning and the classroom learning atmosphere perception in the category of investigate ($r = .581$) and involvement ($r = .562$). In contrast, Significant negative relationships ($p < .01$) were observed between a surface learning approach and various characteristics of the classroom learning environment, ranked in the following order: task orientation, teacher support, cooperation, student cohesiveness, and equity (r = -.231, -.212, -.201, -.197, and -.194, respectively). In terms of motivational goal orientation, the relationship with the surface approach is significantly negative for mastery goal orientation ($r = -.197$). Conversely, the relationship is significantly positive for performance-avoidance goal orientation ($r = .559$) and performance-approach goal orientation ($r = .401$).

Table 2. Correlations Among Study Variables: Perceptions of Classroom Learning Environment, Motivational Goal Orientations and Approaches to Learning (n = 323)

	Perceptions of classroom learning environment							Motivational goal orientation			Approaches to learning	
	SC	**TS**	**IVT**	**IVM**	**TO**	**CO**	**EQ**	**MGO**	**PGO**	**AGO**	**DA**	**SA**
SC		.514**	.431**	.550**	.528**	.578**	.496**	.518**	.080	-.025	.481**	-.197**
TS			.379**	.618**	.427**	.480**	.665**	.486**	.110*	-.061	.464**	-.212**
IVT				.572**	.345**	.303**	.247**	.312**	.188**	.093	.581**	.028
IVM					.508**	.577**	.592**	.427**	.230**	.040	.562**	-.085
TO						.563**	.476**	.570**	.092	.012	.541*	-.231**
CO							.598**	.502**	.102	-.063	.408**	-.201**
EQ								.451**	.103	-.087	.417**	-.194**
MGO									.217**	-.005	.598**	-.197**
PGO										.644**	.256**	.401**
AGO											.164**	.559**
DA												.044
SA												

Note. SC = Student cohesiveness; TS = Teacher support; IVT = Investigation; IVM = Involvement; TO = Task orientation; CO = Cooperation; EQ = Equity; MGO = Mastery goal orientation; PGO = Performance approach goal orientation; AGO = Performance avoidance goal orientation; DA = Deep approach to learning; SA = Surface approach to learning.
*$p < .05$; **$p < .01$

The t-test (Table 3) results indicate that the classroom learning environment perceptions, motivational goal orientations and learning approach in lecture-based and project-based classrooms were statistically differences ($p < .01$).

Table 3. Univariate Analyses of Variance: Perceptions of Classroom Learning Environment, Motivational Goal Orientation, and Approaches to Learning as a Function of Instructional Approach (Lecture-Based Instruction Versus Project-Based Instruction) (n = 323)

	Overall		**Lecture-based instruction**		**Project-based instruction**		**Difference**	
	M	**SD**	**M**	**SD**	**M**	**SD**	**t**	**Effect size**
Student cohesiveness	3.99	0.53	3.83	0.52	4.21	0.45	-6.85**	0.13
Teacher support	4.01	0.78	3.79	0.87	4.29	0.53	-6.42**	0.10
Investigation	3.60	0.64	3.42	0.64	3.82	0.57	-5.86**	0.10
Involvement	3.81	0.68	3.58	0.68	4.11	0.57	-7.44**	0.15
Task orientation	4.22	0.48	4.12	0.46	4.34	0.49	-4.14**	0.05
Cooperation	4.17	0.59	4.09	0.60	4.26	0.55	-2.59**	0.02
Equity	4.11	0.65	3.94	0.67	4.32	0.54	-5.57**	0.09
Mastery Goal Orientation	4.16	0.53	4.06	0.53	4.29	0.50	-4.02**	0.05
Performance Approach Goal Orientation	3.02	0.99	2.87	0.94	3.23	1.03	-3.28**	0.03
Performance Avoidance Goal Orientation	2.91	1.03	2.78	0.98	3.07	1.07	-2.55**	0.02
Deep Approach	3.63	0.56	3.41	0.50	3.91	0.50	-8.78**	0.19
Surface Approach	2.78	0.90	2.69	0.78	2.89	1.02	-1.92	0.01

*$p < .05$; **$p < .01$

Among the classroom learning environment perceptions, involvement emerges as the most significant factor with a substantial difference, followed by student cohesiveness, teacher support, investigation, equity, task orientation, and cooperation, in that order. In terms of motivational goal orientation, involvement also holds a prominent position, followed by performance-avoidance goal orientation and performance-approach goal orientation, respectively, with mastery goal orientation being a major contributing factor. For approaches to learning, the deep approach is a factor with differences while the surface approach is a factor with no correlation in statistics.

Table 4. Multiple Regression Analysis. Variables Predicting Students' Deep Approach to Learning (n = 323)

	Parameter estimates		
Variable	**beta**	**t**	**p-value**
Student cohesiveness	.008	0.164	.870
Teacher support	.020	0.371	.711
Investigation	.329	7.092**	.000
Involvement	.129	2.169*	.031
Task orientation	.162	3.223**	.001
Cooperation	-.075	-1.414	.158
Equity	.068	1.215	.225
Mastery Goal Orientation	.346	6.932**	.000
Performance Approach Goal orientation	-.021	-0.408	.684
Performance Avoidance Goal Orientation	.144	2.928**	.004

*$p < .05$; **$p < .01$ Note: $R^2 = 58.8$, $F = 44.47$

A multiple regression model examined the degree to which each sub-category of the classroom learning environment perceptions (teacher support, student cohesiveness investigation, task orientation cooperation, equity, and involvement) and goal-oriented motivation (performance-approach goal orientation, performance-avoidance goal orientation, and mastery goal orientation) predict approaches to learning. Table 4 shows the findings of the variables predicting students' deep learning approach. The investigation, involvement and task orientation have a positive impact on a deep learning approach. And mastery goal orientation has a positive impact on a deep learning approach.

Table 5 shows that task orientation and performance-avoidance goal orientation have a negative association with a surface learning approach.

Table 5. Multiple Regression Analysis. Variables Predicting Students' Surface Approach to Learning (n = 323)

	Parameter estimates		
Variable	**beta**	**t**	**p-value**
Student cohesiveness	-.065	-1.061	.289
Teacher support	-.123	-1.874	.062
Investigation	.097	1.731	.084
Involvement	.039	0.550	.583
Task orientation	-.171	-2.825**	.005
Cooperation	-.021	-0.323	.747
Equity	.030	0.449	.654
Mastery Goal Orientation	-.082	-1.363	.174
Performance Approach Goal orientation	.129	2.101*	.036
Performance Avoidance Goal Orientation	.459	7.725**	.000

* $p < .05$; ** $p < .01$ Note: $R^2 = 40.0$, $F = 20.90$

Discussion

The survey findings demonstrate a notable and statistically significant positive association between the classroom learning environment and the adoption of a deep learning approach, particularly in the sub-domains of inquiry and active engagement. The finding is consistent between this study and prior research (e.g. Baeten et al., 2016; Pires et al., 2020), which have demonstrated that students who adopt deep learning demonstrate active engagement in the process of learning and the acquisition of skills through participation in activities relating to investigative learning. There are also benefits of investigation and involvement. The investigative learning approach is the process where teacher and students engage in more collaborative involvement helping students gain more knowledge in certain circumstances, rather than traditional learning through reading, memorizing and doing textbook exercises (Sellwood, 1991). Students gain more knowledge through investigating their surrounding environment, which enhances the development of problem-solving skills. These skills are vital for recognizing, analyzing, and solving problems, all of which are important factors in effectively understanding the concept of "learning how to learn". According to Guo et al. (2020), the act of generating new knowledge enables students to experiment with and realize their concepts in their preferred manner, thereby fostering their capacity for innovative competence.

Outcomes from the study show that the perception of learners in a project-based classroom has higher investigation and involvement than in a lectured-based classroom, which is aligned with the project-based learning characteristics. Project-based classroom focuses on teaching through engagement and student investigations (Blumenfeld et al., 1991; Putra et al., 2021). Thomas (2000) suggested that project-based learning still portrays challenging questions on the student's critical thinking process. This includes the student's ability to have proper development in problem-solving skills and judgement process. A project-focused learning environment allows students to work collaboratively and gather information to produce presentations and draw conclusions. This approach provides a foundation for learners to enhance their understanding of a particular knowledge or topic through data collection and information analysis. By engaging in project-based learning, students enhance their competency skills by formulating plans, observing results, and drawing solid conclusions (Jones et al., 1997; Thomas, 2000; Thomas et al., 1999).

These findings underscore the significance of investigative and participatory learning environments for student approach to learning. The implication of this experiment is to better design curriculums with a mixture and balance of both project-based and lectured-based learning. Teachers should focus on designing the curriculum based on the environment where students can perform tasks through investigative and involvement activities in order to promote a deep learning approach. Learners who are task-oriented focus on putting effort into their assignments and receive help, extra care and support from teachers. This approach is moving away from the surface learning approach.

Conclusion

The result of this study confirms that higher-level investigative culture and learner involvement in the project-based classroom have a positive connection with a "deep learning approach". Additionally, this experiment found that high-level task orientation in the project-based classroom was negatively associated with a "surface learning approach". The guidelines recommended in this research aim to address the importance of curriculum design with a mixture of different types of learning environments. Teachers should prioritize enhancing students' critical thinking skills and their ability to perform effectively. This can be achieved by engaging them in investigative and participatory activities that highly involve a deep approach to learning. Instead of merely focusing on creating an environment where students memorize information, teachers should emphasize the improvement of student's abilities in critical thinking and encourage active engagement with the subject matter.

Recommendations

The framework recommended for this study is to portray the importance of curriculum design with a combination of different learning environments. Teachers must focus on guiding students towards the improvement of their critical thinking skills. This can be achieved by fostering investigation, active involvement, and a task-oriented approach which promotes a deep learning approach. Therefore, to make this beneficial for future research, the author recommends further research on the factors or patterns to enhance classroom environment as investigating, involving and being task-oriented. This will help in designing teaching methods for higher levels in schools and better performance of the students.

Limitations

As a result, this study has limitations on the sample group used in investigating the correlation between the classroom learning environment perceptions among students, motivational goal orientation and learning approach with different sample groups in the classroom. Although the students may be from different sample groups, the core course is still the same.

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Authorship Contribution Statement

Paleenud: Conceptualization, design, data acquisition, analysis, writing. Tanprasert: Editing/reviewing, supervision. Waleeittipat: Statistical analysis/interpretation.

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