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Exploring the Relationship between 21st Century Skills and Motivation: A Study Using Contextual Inquiry Project-based Learning

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Abstract: Motivation has gained considerable attention as educators and researchers seek to understand and nurture the diverse set of 21st century skills required for individuals to thrive in the rapidly evolving landscape of the 21st century. These skills, including critical thinking, collaboration, problem-solving, creativity, and self-direction, among others, are crucial for success in various professional and personal contexts.This study investigates the relationship between 21st-century skills and motivation within the framework of Contextual Inquiry Project-based Learning (CI-PBL). The purpose of the study is to gain insights into how motivation influences the development of various 21st-century skills. The research employs Pearson's correlation coefficient to analyze the relationship between motivation and these skills. The study aims to provide a comprehensive understanding of the strength and direction of the correlations, revealing potential patterns and associations between motivation and skill development.

Keywords: Contextual Inquiry Project-based Learning, Project-based learning, Motivation, 21st Century Skills, ICT innovation in education

1. Introduction

In the rapidly evolving landscape of education, there is a growing recognition of the need to equip students with skills that are relevant to the demands of the 21st century. These skills, often referred to as 21st century skills, encompass a wide range of abilities and competencies that enable individuals to navigate and thrive in the modern world. Some of the key skills emphasized in this context include critical thinking, creativity, collaboration, problem-solving, self-direction, meaningful learning with Information and communication technology, and knowledge creation efficacy.

Individuals' levels of interest, perseverance, and effort in learning and using new skills are greatly influenced by their motivation. It is well known that it plays a crucial role in educational settings since it affects students' capacity to set objectives, control their learning processes, and deal with difficulties. Despite the fact that the importance of motivation in the classroom is generally known, research on the precise connection between motivation and 21st century abilities is still underway.

Explore the 21st Century Skills and competencies that are essential for learners in Asia to succeed in the new millennium. The rapid changes brought about by globalization and technological advancement require learners to possess a new set of skills and competencies that go beyond traditional academic knowledge and skills.

Through a study utilizing contextual inquiry project-based learning, this research seeks to analyze this relationship. The study will look at how this strategy can help students develop both of these skill sets more effectively. We intend to learn more about the connections between these two sets of talents and how they might be effectively cultivated using cutting-edge teaching strategies via the course of this research. The results of this study could have a big impact on how educators and policymakers create educational programs that support the growth of computational thinking and 21st century abilities. We can prepare pupils for life in a complicated, technologically advanced environment by giving them these abilities.

The investigation of this relationship study aims to contribute to the existing body of research on both motivation and 21st century skills. By uncovering potential correlations and patterns, educators and researchers can gain valuable insights into the dynamics between motivation and skill development, informing instructional practices and curriculum design.

The research questions in this study are as follows:

- What is the nature and strength of the correlation between motivation and various 21st century skills?
- How does motivation influence the development and application of 21st century skills within the CI-PBL framework?

2. Literature Review

2.1 21st Century Skill

21st-century skills refer to a set of competencies that are considered essential for success in the modern world. These skills go beyond traditional academic knowledge and include abilities such as critical thinking, problem-solving, collaboration, communication, creativity, and digital literacy. According to the World Economic Forum, these skills are becoming increasingly important due to factors such as globalization, technological advances, and the changing nature of work (World Economic Forum, 2018).

Several frameworks have been developed to define and organize 21st-century skills. One popular framework is the Partnership for 21st Century Skills (P21) Framework, which identifies four key categories of skills: (1) communication and collaboration, (2) critical thinking and problem-solving, (3) creativity and innovation, and (4) digital literacy (Partnership for 21st Century Skills, 2015).

Research has shown that developing 21st-century skills can lead to a range of positive outcomes for students, including improved academic performance, increased engagement, and better preparation for future careers (Trilling & Fadel, 2009; Griffin, McGaw, & Care, 2018). However, there are also challenges associated with integrating 21st-century skills into traditional educational practices, such as resistance to change, lack of teacher training, and difficulty in assessing these skills (Voogt et al., 2015).

21st Century Skill by Chai Ching Sing, et al. (2015) is a research paper that proposed a framework for assessing students' perceptions of 21st-century learning practices. The framework includes seven dimensions of 21st-century skills:

1. Self-directed learning (SDL): the ability to take responsibility for one's own learning.
2. Meaningful learning with Information and communication technology (MLT) : the ability to use technology as a tool for promoting student-centered, collaborative, and authentic learning experiences that align with the demands of the 21st-century workplace (Jang et al., 2017)
3. Collaborative learning(CoL): the ability to work effectively in teams and share knowledge with others
4. Critical thinking(CriT): the ability to analyze information and make informed decisions
5. Creative thinking(CreT): the ability to generate and develop innovative ideas and solutions

6. Authentic problem-solving(APS): the ability to solve real-world problems using critical and creative thinking skills
7. Knowledge creation efficacy (KCE) : the ability to develop new knowledge through collaboration and efficient learning process.

The paper argues that these seven dimensions of 21st-century skills are essential for students to succeed in the modern world and that educators should prioritize the development of these skills in their teaching practices.

2.2 Motivation

Motivation is the driving force that underlies behavior and actions. It refers to the internal and external factors that influence the direction, intensity, and persistence of behavior (Ryan & Deci, 2020). Motivation plays a critical role in learning and achievement, as it can impact students' engagement, effort, and performance.

Researchers have identified several strategies for fostering motivation in educational settings, such as providing meaningful and challenging tasks, promoting autonomy and choice, giving feedback, and creating a supportive learning environment (Brophy, 2021).

The previous study highlights the effectiveness of project-based learning as a strategy for promoting computational thinking skills and motivating students in computer science education. By engaging students in authentic and hands-on programming projects, the approach allows them to apply computational thinking principles in real-world contexts, enhancing their understanding and interest in the subject matter (Thanyaphongphat et al., 2022). There exist six distinct dimensions that encompass the concept of motivation.

1. IM (Intrinsic Motivation): Intrinsic motivation is the natural desire and interest in doing something for its own sake, such as because you enjoy it or are curious about it. It's important to include this factor because it helps show how interested and passionate people may be about the subject. It's a key way to figure out what really drives people to be engaged.
2. PG (Personal Goals): Personal goals are the hopes, dreams, and goals that a person has for their own academic or personal growth. This factor shows how students' motivation is tied to their own goals, which can be different and can drive their hard work and dedication.
3. EM (Extrinsic Motivation): When someone does something for external benefits or to avoid bad things, this is called extrinsic motivation. This can be based on things like grades, awards, or social acceptance. It's important to include this factor to account for the different motivations that can come from outside sources, which can affect how engaged students are.
4. AC (Anxiety about Computer Science Assessment): Worrying about tests in a certain topic, like computer science, can have a big effect on how motivated students are to learn. This dimension focuses on the emotional side of motivation, showing how worry can both help and hurt motivation. It's important to think about worry because it can change how you learn.
5. SD (Self-Determination): Self-determination is a person's sense of being in charge of their own acts and decisions. This factor is very important for figuring out how much control students feel they have over their learning. Self-determined students are more likely to be self-motivated and interested in school.
6. SE (Self-Efficacy): Self-efficacy is a person's belief that they can do a job or reach a goal on their own. It's a very important factor because it directly affects how hard students are willing to work on a topic. High self-efficacy can help students work harder and get more done.

2.3 Project-based learning

Project-based learning has emerged as a promising approach to fostering both 21st century skills and computational thinking. Contextual Inquiry Project-based Learning, in particular, has been shown to be an effective way of promoting these skills. According to Hsu et al.

(2018), this approach involves students in a collaborative project that is based on a real-world problem. The students are guided through the project with the aim of developing 21st century skills and computational thinking. This approach has been shown to be effective in enhancing students' problem-solving abilities, critical thinking, and collaboration skills (Hsu et al., 2018).

2.4 Contextual Inquiry

Contextual inquiry is a qualitative research method used to understand users' behaviors and needs in the context of their work or daily lives. The method involves observing and interviewing users in their natural environment and analyzing the data collected to identify patterns and insights. Contextual inquiry is commonly used in user-centered design and can be applied to a variety of contexts, including healthcare, education, and technology.

One of the key features of contextual inquiry is the emphasis on observation and participation. Researchers not only observe users but also participate in their activities to gain a deeper understanding of their experiences. This approach allows researchers to identify implicit needs and behaviors that may not be apparent through traditional surveys or interviews.

Another important aspect of contextual inquiry is the use of contextual data to inform the design process. Researchers collect data on the physical environment, tools, and artifacts used by users, as well as their social and organizational contexts. This information can be used to develop design solutions that are tailored to users' needs and contexts.

2.5 Contextual Inquiry Project-based Learning

Contextual Inquiry Project-based Learning (CI-PBL) is an instructional approach that combines the Contextual Inquiry research method with Project-based Learning (PBL) to promote meaningful and authentic learning experiences. This approach involves having students engage in inquiry-based projects that are grounded in real-world contexts and that involve the use of technology. These steps are seven steps for learning:

1. Motivate and Prepare: This step involves building motivation and preparing students with the foundational knowledge and necessary skills for the project.
2. Analyze: In this step, students analyze the problem and make connections to the context in which the project is taking place.
3. Plan: This step involves planning the project and determining how the problem will be solved.
4. Do: In this step, students implement their plan by taking action and solving the problem.
5. Examine & Evaluation: In this step, students examine and evaluate their work to determine its effectiveness and to identify areas for improvement.
6. Explore & Expand: This step involves exploring new knowledge and expanding the scope of the project beyond the original problem.
7. Develop & Distribute: In the final step, students develop and distribute their work to others, sharing their solutions and knowledge with a wider audience.

By following these seven steps, students can engage in authentic, inquiry-based learning that helps them develop critical thinking, problem-solving, communication, and collaboration skills. The CI-PBL approach allows students to take ownership of their learning and connect academic concepts to real-world contexts, making learning more meaningful and relevant to their lives.

Research has shown in Figure 1 that the CI-PBL approach can be effective in promoting the development of 21st-century skills such as critical thinking, creativity, communication, and collaboration. For example, a study by Lee and Wu (2019) found that using a Contextual Inquiry Project-based Learning approach in a college-level computer science course led to improvements in students' critical thinking and problem-solving skills.

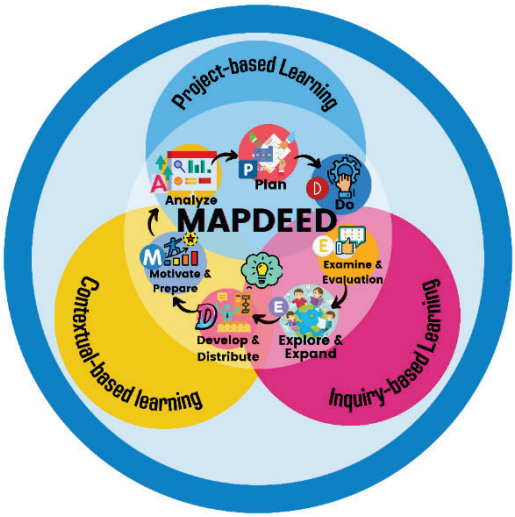

Figure 1. The Contextual Inquiry Project-based Learning approach.

2.6 Relationship between 21st-Century Skills and Motivation in PBL using Contextual Inquiry

There is growing evidence that the development of 21st-century skills is positively related to students' motivation to learn. Research suggests that when students are engaged in tasks that require them to use 21st-century skills such as critical thinking, creativity, and collaboration, they are more likely to be intrinsically motivated and engaged in their learning (Kirschner & van Merriënboer, 2013).

In addition, project-based learning (PBL) is an instructional approach that is often used to develop 21st-century skills and foster student motivation. PBL involves students working on real-world problems or challenges and requires them to use a range of 21st-century skills such as communication, collaboration, and problem-solving (Hung et al., 2008). Studies have found that PBL can increase student motivation, engagement, and achievement (Krajcik et al., 2014).

3. Methodology

3.1 Participants

The students from northern Thai high schools (grades 7) participated in the pilot project. The same teachers taught the same unit content for groups. This class had twenty-five combined students: thirteen males and twelve females.

3.2 Instrument

The instrument used to assess student motivation was modified from the questionnaire developed by Panjaburee and Srisawasdi (2016), which had a scale reliability of 0.89. The estimated value of 29 items on Likert's Scale (Likert's Scale). The questionnaire scores were allocated a five-level Rating Scale: least, less, moderate, very, and most, which was then translated into Thai by a language expert. Then, retest the confidence with a Cronbach's alpha confidence of 0.928, which indicates extremely high confidence.

The 21st Century Skills Questionnaire was made by Chai Ching Sing, et al(2015) with a Cronbach's alpha confidence score of 0.95. We then translated it into Thai. There were 42 questions on the poll, six for each scale. The poll questions were shown on a five-point Likert scale, with 1 being strongly disagree and 5 being strongly agree. The Thai version was used, and Cronbach's alpha was 0.90, which means there was a very high level of confidence and that it could be used to evaluate 21st Century Skills reasoning in seven different areas.

An open-ended questionnaire focused on the activities that students enjoyed and the experiences that left a significant impression on them.

3.3 Research Design

To investigate the relationship between 21st century skills and motivation skills.The Contextual Inquiry Project-based Learning approach is combined with the context-based inquiry-based learning management to promote 21st-century skills and enhance the motivation of grade 7 students to learn science subjects, specifically Computational Science. The program consists of Level 1, with 1 hour per session, totaling 18 hours, and includes the following units:

- Unit 1: Digital Intelligence (2 hours)
- Unit 2: Digital Problem Solver (2 hours)
- Unit 3: Digital Inventor (10 hours)
- Unit 4: Digital Data Management (4 hours)

The learning activities are designed to integrate skills, processes, and experiences. The content is arranged in order to increase difficulty, catering to the original skills of the learners. Both individual and group activities are included. For group activities, students will be divided into groups of 3-4 people and work together on activity sheets.

The Learning Management Plan for Unit 3, "Digital Inventor," consists of a 10-hour session for students, with 1 hour dedicated to problem-solving steps. The breakdown of activities is as follows:

- Coding Heart Rate: 1 hour
- Car Coding: 2 hours
- Fan Coding: 3 hours
- Digital Inventor: 3 hours

To support the learning process, various materials will be utilized, including activity sheets, knowledge sheets, slides, and teaching media. Additionally, each student will be provided with one Micro:bit board.

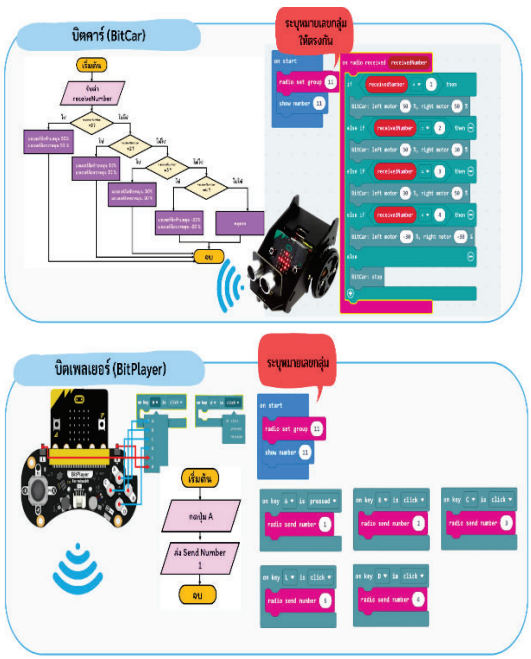

Figure 2. Example Car Coding activity in Digital Inventor unit.

4. Results and Discussions

In order to determine the impact of CI-PBL on Computer Science education, Table 1 displays the level of student motivation after learning. It asserts that the majority of student

learning incentives were positive. In contrast, the evaluation component generated the least amount of anxiety. It indicates that students are not anxious about the test. These results demonstrate that CI-PBL can motivate all students to study Computer Science.

Table 1 *Means and SD of the Students' Motivation Towards the Contextual Inquiry Project-based Learning in Computer Science.*

Learning Motivations Dimensions	Mean	SD.	SE.	Remark
IM (Intrinsic Motivation)	3.7920	0.61232	0.12246	Agree
PG (Personal Goals)	3.6960	0.75082	0.15016	Agree
EM (Extrinsic Motivation)	3.5840	0.72093	0.14419	Agree
AC (Anxiety about Computer Science Assessment)	2.1360	0.77399	0.15480	Disagree
SD (Self-Determination)	3.6720	0.59127	0.11825	Agree
SE (Self-Efficacy)	3.5120	0.57178	0.11436	Agree

For another query data analysis, Pearson's correlation coefficient was used to examine the relationship between the six motivational dimensions. From Table 2, it was shown that the highest positive correlation existed between the intrinsic (IM) dimension and the self-determination (SD) dimension significantly ($r = 0.867$, $p < 0.01$) means that students participate in learning activities with intrinsic motivation and self-determination motivation. They can complete their projects in other ways. Both motives can increase interest and enjoyment in learning. Other significant associations were found between anxiety about the computer science (AC) assessment and self-determination (SD) dimensions. However, the fear of failing the computer science exam affected their decision-making.

Table 2 *Pearson's correlation coefficient between motivation and twenty-first century motivation.*

Learning Motivations Dimensions	IM	PG	EM	AC	SD	SE
IM (Intrinsic Motivation)	1	0.796**	0.532**	0.319	0.867**	0.674
PG (Personal Goals)	0.796**	1	0.797**	0.174**	0.798**	0.661**
EM (Extrinsic Motivation)	0.532**	0.797**	1	0.118	0.636**	0.655**
AC (Anxiety about Computer Science Assessment)	0.319	0.174	0.118	1	0. 397*	0.288
SD (Self-Determination)	0.867**	0.798**	0.636**	0.397*	1	0.695**
SE (Self-Efficacy)	0.674**	0.661**	0.655**	0.288	0.695**	1**

** Correlation is significant at the 0.01 level (2-tailed).
* Correlation is significant at the 0.05 level (2-tailed).

According to the findings presented in Table 3, the implementation of the learning model resulted in significant improvements in the 21st century skills of the student sample group. Specifically, there was a notable enhancement across five key aspects of these skills: self-directed learning (SDL), collaborative learning (CoL), meaningful learning with ICT (MLT), critical thinking (CriT), creative thinking (CreT), authentic problem-solving (APS), and knowledge creation efficacy (KCE). All of these skills showed a statistically significant increase at the .01 level. Notably, meaningful learning with ICT skills exhibited the highest average score of 4.0240, showcasing the notable impact of this learning approach.

Table 3 Paired-samples t-test analysis Twenty-first-century skills comparing pre-test and post-test scores.

		Mean	SD.	SE.	t	p
SDL	Pre-test	3.0080	0.60685	0.12137	-8.492	.000
	Post-test	4.0080	0.49826	0.09965		
MLT	Pre-test	2.8560	0.62322	0.12464	-11.947	.000
	Post-test	4.0240	0.55474	0.11095		
CoL	Pre-test	3.3520	0.90052	0.18010	-3.604	.001
	Post-test	4.0080	0.64415	0.12883		
CriT	Pre-test	3.0400	0.82977	0.16595	-6.006	.000
	Post-test	3.9600	0.68927	0.13785		
CreT	Pre-test	3.1700	0.94846	0.18969	-2.861	.009
	Post-test	3.7400	0.68648	0.13730		
APS	Pre-test	2.7440	0.56427	0.11285	-10.200	.000
	Post-test	3.9040	0.60033	0.12007		
KCE	Pre-test	2.7760	0.74234	0.14847	-7.636	.000
	Post-test	3.8240	0.66663	0.13333		

**p < .01

In Table 4, Intrinsic Motivation is positively correlated with most of the twenty-first century skills. Positive correlations indicate that as motivation increases, the corresponding twenty-first century skills also tend to increase. Motivation has a positive and significant correlation with MLT (0.638), CriT (0.775), CreT (0.679), APS (0.265) , SDL (0.443), and KCE (0.388).

In contrast, Motivation shows weaker or non-significant correlations with Social and Emotional Learning (SEL) and Active Citizenship (AC). The correlation coefficients for these skills range from -0.223 to 0.126, indicating a weaker or negligible relationship between motivation and these particular skills.

Table 4 *Pearson's correlation coefficient between motivation and twenty-first century skills.*

	SDL	MLT	CoL	CriT	CreT	APS	KCE
IM	0.443**	0.638**	0.773	0.775**	0.679**	0.265**	0.388*
PG	0.430	0.691**	0.801	0.732**	0.778**	0.502**	0.591*
EM	0.404**	0.772	0.725	0.602**	0.623**	0.659*	0.701**
AC	-0.223	0.085	0.081	0.015*	0.018	0.065	0.126
SD	0.422**	0.645**	0.642*	0.593	0.633**	0.443**	0.516*
SE	0.377**	0.653**	0.672	0.681**	0.672	0.630*	0.666*

**p < .01

There are positive correlations between most of the twenty-first century skills factors.Positive correlations indicate that as one skill factor increases, the corresponding skill factors also tend to increase. The highest positive correlations are observed between several pairs of skills factors, indicating strong associations between them. For example, there are strong positive correlations between CoL and CriT (0.820) , CoL and MLT(0.769), CoL and CreT(0.697), CoL and SDL (0.493) , CoL and APS (0.433), and Collaboration and Knowledge creation efficacy (KCE) (0.578). These correlations range from 0.697 to 0.820,

suggesting that these skills factors tend to be positively related and may complement each other in practice.

Table 5 *Pearson's correlation coefficient among the seven twenty-first century skills factors.*

	SDL	MLT	CoL	CriT	CreT	APS	KCE
SDL	1*	0.518*	0.493	0.648*	0.475	0.315*	0.556
MLT	0.518**	1**	0.769	0.598**	0.460**	0.638*	0.643**
CoL	0.493**	0.769**	1	0.820**	0.697**	0.433*	0.578*
CriT	0.648**	0.598**	0.820	1**	0.732**	0.434**	0.584*
CreT	0.475**	0.460**	0.697	0.732**	1**	0.245*	0.547
APS	0.315*	0.638**	0.433	0.434*	0.245**	1	0.743*
KCE	0.556**	0.643**	0.578	0.584**	0.547**	0.743	1*

**p < .01

Furthermore, the students were engaged in an open-ended questionnaire that specifically centered on identifying activities that they derived pleasure from. The results of the study revealed that students placed a high level of importance on engaging in group activities, participating in coding exercises that involved the utilization of Micro:bit boards, and engaging in programming tasks. They cherished opportunities to initiate projects and independently produce work, particularly in activities such as Fan Coding and Car Coding. Students appreciated the chance to present their personal work, especially in the Fan Coding activity where they were able to program a Micro:bit board to control a fan based on their design specifications and create fan models reflecting their innovative concepts. In terms of experiences that left a lasting impression on the students, it was discovered that students were struck by the teacher's support during activities, the ability to independently troubleshoot problems, and the collaboration with peers. Students articulated, "Initially, I was unable to complete the task, but after acquiring knowledge and making an effort, I felt a sense of pride and enjoyment." This feedback illustrates that such activities can enhance motivation for learning and cultivate competencies for the 21st century, specifically in the realms of cooperative and self-directed learning.

5. Conclusion

Research has shown that Contextual Inquiry Project-based Learning can be effective in promoting the development of 21st-century skills such as critical thinking, collaboration, and communication. Similarly, a previous study by Chen and Chang (2016) found that students who participated in a Contextual Inquiry Project-based Learning project showed significant improvements in their critical thinking skills. This aligns with the existing body of research on the utilization of suitable digital media, which has been shown to enhance student motivation and learning efficiency (Thanyaphongphat, 2019).

These results only show associations between motivation and twenty-first century skills, but they do not indicate that one directly causes the other. Furthermore, other factors not considered in this analysis may also contribute to the development of these skills.

Future research projects could commence by analyzing student behavior through observations and conducting in-depth interviews to gather qualitative insights. Employing this approach would provide a comprehensive understanding of the situation. In subsequent studies, robust statistical tests could be employed to validate findings, leveraging a larger participant pool. Additionally, it is recommended that future investigations explore the

adaptability of the Contextual Inquiry Project-based Learning method across various digital learning contexts. These aspects share commonalities and possess the potential to contribute to our existing knowledge.

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