Advances in Management & Applied Economics, Vol. 15, No. 3, 2025, 45-63
ISSN: 1792-7544 (print version), 1792-7552(online)
https://doi.org/10.47260/amae/1533
Scientific Press International Limited

Project-Based Learning in Financial Literacy Education: Effects on Learning Outcomes and Motivation Across Cognitive Styles

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Abstract

This study investigates the effectiveness of Project-Based Learning (PBL) in financial literacy education and examines how Global and Sequential cognitive styles affect learning outcomes and motivation. Using a pre-test/post-test design with 21 university students, the study measured financial literacy improvement and changes in motivation factors through assessments and the Motivated Strategies for Learning Questionnaire (MSLQ). Results showed that PBL significantly improved financial literacy ($t = 2.609$, $p = .017$), with no significant differences in improvement rates between cognitive styles ($t = -0.628$, $p = .538$), suggesting PBL is equally effective for both Global and Sequential learners. All students showed significant improvement in Self-Efficacy ($t = 2.454$, $p = .023$), with Global learners demonstrating particularly significant improvement in Control Beliefs ($t = 2.409$, $p = .035$). This study highlights the effectiveness of PBL in financial literacy education, emphasizing its role in improving self-efficacy and strengthening control beliefs, while also underscoring the importance of tailoring instructional strategies to accommodate different cognitive styles. These findings offer insights into how AI-assisted PBL, particularly through generative AI (GAI), could be applied in the future to provide personalized learning support, enhancing learning outcomes and experiences for students with diverse cognitive styles.

JEL classification numbers: A22, D14, I21, I23.
Keywords: Financial Literacy, Project-Based Learning (PBL), Cognitive Styles, Learning Motivation, Self-Efficacy, Control Beliefs.

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Article Info: *Received:* March 6, 2025. *Revised*: March 21, 2025.
Published online: March 25, 2025.

1. Introduction

According to the 2020 OECD International Financial Literacy Survey, financial literacy remains a global challenge, with many individuals lacking the fundamental knowledge necessary for informed financial decision-making. The situation is further complicated by the increasing importance of digital financial literacy, as insufficient understanding in this area can exacerbate financial difficulties and negatively impact personal financial health.

Recent data from the 2023 OECD/INFE International Survey of Adult Financial Literacy reveal that across 39 countries and economies, the global average score for digital financial literacy is only 53 out of 100, with merely 29% of adults meeting the minimum proficiency threshold of 70. Although 84% of adults are familiar with the concept of inflation-likely due to recent global inflationary pressures-only 63% can correctly apply the time value of money to personal savings, and while 77% recognize the relationship between risk and return, only 42% can accurately calculate compound interest (OECD, 2023). These findings highlight critical gaps in financial knowledge, even among adults in OECD-participating countries.

1.1 Financial Literacy Challenges in Taiwan

Shifting focus to Taiwan, the 2022 Taiwan Financial Life Survey conducted by the Taiwan Academy of Banking and Finance underscores similar concerns. Notably, among individuals aged 20 to 29, financial risk resilience has declined-making them the only demographic group to exhibit a worsening financial outlook. This is largely attributed to low financial literacy among young adults. Alarmingly, 72.2% of individuals with junior college or university education demonstrate low financial literacy, with 32.8% categorized as "extremely low" and 39.4% as "low."

These findings suggest that traditional school-based financial education has limited effectiveness. The identified issues include a lack of structured financial education curricula, insufficient teaching experience in financial education, and a shortage of professional financial knowledge among educators. Addressing these deficiencies requires an innovative approach to financial literacy education-one that goes beyond theoretical instruction and actively engages students in real-world financial decision-making.

1.2 Project-Based Learning (PBL) as a Solution

Financial literacy is more than just knowledge; it encompasses awareness, skills, attitudes, and behaviors that enable individuals to make sound financial decisions and achieve financial well-being (OECD, 2020). It is also a critical life competency that helps individuals navigate financial crises (Opletalová, 2015) and apply effective financial decision-making in daily life (Pan, Lin, & Lin, 2024).

One promising pedagogical approach to address these challenges is Project-Based Learning (PBL). Despite its potential, research shows that only 20% of studies on PBL strategies focus on higher education (Guo, Saab, Post, & Admiraal, 2020), leaving a significant gap in understanding its applicability in financial literacy education.

When students lack practical experience in financial matters, merely explaining economic terms and their interconnections in class is insufficient for meaningful learning (Chou, 2015). Even when financial concepts are integrated into mathematics curricula, such approaches often fail to provide a comprehensive and structured framework for teaching financial knowledge and financial decision-making attitudes (Sagita et al., 2022). To bridge this gap, an experiential, project-driven learning strategy is needed—one that immerses students in meaningful financial decision-making scenarios and fosters hands-on learning experiences.

Therefore, a learning strategy driven by meaningful project work, which minimizes distractions and effectively builds students' preparedness through hands-on experience, is a key development in financial literacy education. Project-based learning (PBL) also helps students stay motivated and engaged throughout the learning process (Blumenfeld et al., 1991).

This study explores the impact of a PBL curriculum on university students' financial literacy learning outcomes, with a specific focus on learning styles (sequential vs. global) and psychological changes throughout the learning process. In this approach, students engage in PBL activities centered around the creation of e-books, allowing them to actively explore financial concepts and apply them in real-world contexts. However, several critical questions remain:

1. Does PBL significantly enhance financial literacy learning outcomes?
2. Do different learning styles (sequential vs. global) influence the effectiveness of PBL?
3. Can PBL improve students' psychological factors, such as self-efficacy and locus of control?

By investigating these dimensions, this study aims to contribute both theoretical insights into financial literacy education and practical recommendations for educators seeking to improve financial literacy through Project-Based Learning (PBL).

2. Literature Review

2.1 Project-Based Learning (PBL) in Business Education

Project-Based Learning (PBL) is an instructional approach that emphasizes active engagement through complex and authentic projects, allowing students to take ownership of their learning. This method encourages learners to select topics, define challenges, create action plans, collect data, analyze problems, explore solutions, make decisions, and present their findings. Rooted in inquiry-based learning (Blumenfeld et al., 1991), PBL fosters a more interactive and student-centered educational experience.

Research suggests that PBL enhances the integration of theoretical knowledge with practical application by facilitating idea generation, discussion, and opinion exchange. This active learning process shifts students away from passive absorption

of information, leading to greater engagement, deeper conceptual understanding, and increased interest in coursework (Helle, Tynjälä, & Olkinuora, 2006; Ralph, 2016).

While empirical studies on the application of PBL in financial education remain limited, its adoption in higher education business courses has been steadily increasing. Research indicates that this teaching strategy positively influences learning outcomes across various financial disciplines. For example, PBL has been shown to enhance students' comprehension of key financial concepts, such as financial accounting principles (Abdul Manaf et al., 2011), financial statement analysis (Yang, 2017), and corporate finance (Parrado-Martínez & Sánchez-Andújar, 2020).

Moreover, studies highlight that PBL fosters critical thinking and collaboration skills, enabling students to establish connections between global financial issues and theoretical concepts found in textbooks (Young & Legister, 2018). Further research suggests that PBL also enhances self-efficacy, particularly among students with disabilities and learning challenges in higher education (Pan et al., 2024).

2.2 The Role of Cognitive Styles (Global vs. Sequential) in Learning

Cognitive style is a key factor influencing students' learning across different contexts and plays a crucial role in designing scenario-based learning environments across various academic disciplines (Chen, Chen, and Chien, 2017). Understanding students' cognitive style preferences provides several benefits, including helping them recognize their strengths and identify areas where they may encounter academic challenges. Additionally, in team-based settings, awareness of one's own and teammates' cognitive styles can foster better communication and collaboration, reducing interpersonal conflicts that might otherwise hinder group work (Felder, 2020).

The Felder-Silverman (FS) model is a widely recognized framework for classifying cognitive styles. Among its categories, Global and Sequential cognitive styles are the most frequently studied and the least controversial in research (Felder, 2020). According to Felder (1996), cognitive style preferences refer to "the typical strengths and preferences in how individuals acquire and process information."

Sequential learners prefer to organize information in a linear, structured manner. They learn best by following logical, step-by-step processes, systematically building their understanding in an orderly fashion. In contrast, Global learners process information holistically, often in a nonlinear and seemingly random manner. While their thought processes may appear scattered and disorganized at first, they often arrive at creative insights or unexpectedly accurate solutions (Jonassen & Grabowski, 2012; Felder, 2020).

Research has demonstrated that learning outcomes differ based on Global and Sequential cognitive styles. Studies indicate that when real-time, adaptive support is provided by teachers or peers during the learning process, Global learners tend to perform significantly better than Sequential learners across various dimensions of

learning. However, when educators pre-structure learning tasks and provide scaffolded support at key difficulty points, Sequential learners outperform Global learners in terms of overall learning performance (Chang & Yang, 2023).

These findings highlight the importance of tailoring instructional strategies to accommodate different cognitive styles. While Global learners benefit from flexibility and exploratory learning, Sequential learners thrive in structured, guided environments. Understanding these differences can help educators design more effective learning experiences that maximize student engagement and comprehension.

2.3 Psychological Factors Influencing Learning Outcomes (MSLQ)

Motivation is defined as the force that directs, sustains, and regulates behavior, encompassing its direction, intensity, and persistence (Keller, 2016). It determines whether motivation can be externally observed through behavioral actions (Gero & Danino, 2016). Motivation, along with the development of learning strategies, plays a crucial role in self-regulated learning, directly impacting students' academic performance (Salvador et al., 2017). Research suggests that examining the interaction between the learning environment and students' behavior, cognition, and motivation provides valuable insights into how teaching can cultivate self-directed learners (Stefanou et al., 2013).

The Motivated Strategies for Learning Questionnaire (MSLQ) was developed to assess university students' motivational tendencies and their use of learning strategies in academic settings (Pintrich, 1991). It evaluates three key dimensions: value, expectancy, and affect, encompassing Intrinsic Motivation, Extrinsic Motivation, Work Values, Control Beliefs, Self-Efficacy, and Learning Anxiety (Pintrich et al., 1993; Pan et al., 2004).

Intrinsic motivation refers to behavior driven by interest and internal satisfaction, including curiosity, exploration, spontaneity, and the desire to master and assimilate knowledge (Pintrich & DeGroot, 1990). In contrast, extrinsic motivation involves engaging in activities to attain specific external rewards, such as students prioritizing academic credits over the intrinsic value of higher education. However, external motivations can be gradually internalized, transforming into self-determined behaviors through structured interventions (Jacobson & Harris, 2008).

Self-efficacy refers to students' belief in their ability to effectively apply knowledge and skills to new situations, thereby fostering the development of higher-order cognitive abilities (Schunk, 1989; Butler & Winne, 1995). It is closely linked to control beliefs, which influence how individuals regulate thought processes, motivation, emotions, and overall psychological states (Bandura, 1997). Given that learning is a multidimensional process, it should not be solely measured by single academic performance indicators. The MSLQ offers a comprehensive framework for exploring the psychological factors that shape financial literacy education, providing insights into how motivation, self-efficacy, and control beliefs influence students' ability to develop sound financial decision-making skills.

3. Sample and Methodology

3.1 Research Design and Participants

As shown in Figure 1, this study follows a one-group pretest-posttest design. The experimental group participated in a 10-week course, with the first week focusing on activities such as practicing bank deposit and withdrawal slips to stimulate motivation, as well as a course introduction and a pre-test. From week 2 to week 7, the course activities covered topics such as savings and time deposits, life insurance, the time value of money, financial lending, the stock market, stock rights and dividends, and more. Students were required to complete an e-book. In weeks 8 and 9, the teacher took on the role of scaffolding, providing guidance to students as they created their e-books related to the course content. In week 10, a post-test on financial knowledge was conducted, accompanied by the use of the Motivated Strategies for Learning Questionnaire (MSLQ) to assess intrinsic motivation, extrinsic motivation, work values, control beliefs, self-efficacy, and learning anxiety, in order to understand the impact of the PBL learning strategy.

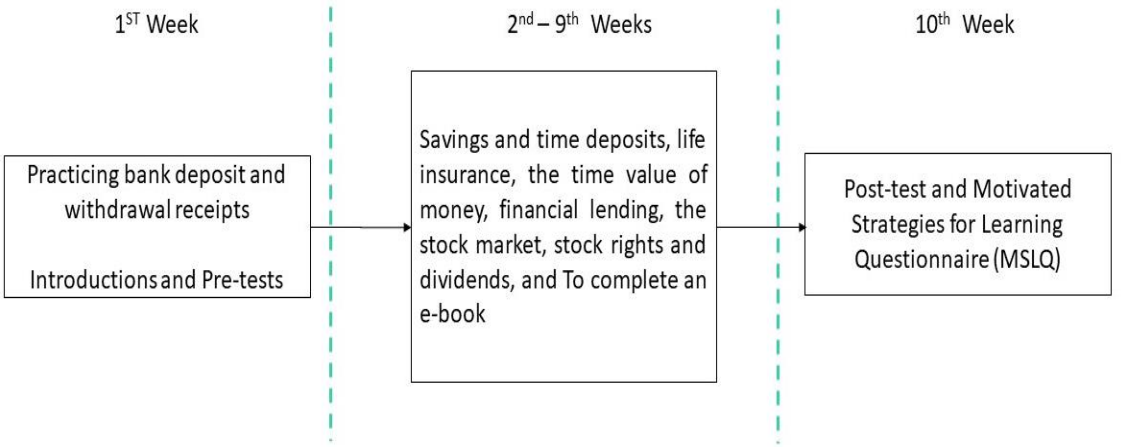

Figure 1: Research Experiment Flowchart: One-group Pretest-Posttest Design and Assessment Over-view

This study recruited 23 university students majoring in Information Management from the eastern region of Taiwan. They came from northern, central, southern, and eastern Taiwan. However, two students withdrew from the study in the later stages of the instructional experiment, so statistical analysis was based on the 21 students who fully participated in the financial literacy PBL course. All students attended the same classes, and the classification of cognitive styles was not used to distinguish between experimental and control groups, but rather to explore learning differences. The course content, assessment methods, and instructors were the same for all students, with the only difference being the students' e-book projects. Data collection was conducted through a Google Forms survey.

3.2 Measurement Instruments

This study employed three measurement instruments to assess students' financial literacy, psychological factors, and cognitive styles.

The financial literacy assessment used in this research consists of 20 multiple-choice items, designed to evaluate changes in students' financial knowledge and decision-making behaviors. These items were reviewed by subject matter experts to ensure content validity and alignment with key financial literacy concepts.

To measure students' motivation and self-regulated learning strategies, this study adopted the Motivated Strategies for Learning Questionnaire (MSLQ) (Pintrich, 1991). The MSLQ evaluates intrinsic motivation, extrinsic motivation, work values, control beliefs, self-efficacy, and learning anxiety through 31 self-report items rated on a 5-point Likert scale (1 = strongly disagree, 5 = strongly agree). Internal consistency analyses from various studies have reported Cronbach's α values ranging from 0.612 to 0.90 across different language versions, confirming the instrument's reliability and validity.

To classify students' cognitive styles (Global vs. Sequential), this study employed the Study Preference Questionnaire (SPQ) (Ford, 1985). The SPQ is an 18-item instrument designed to identify whether learners exhibit a Global or Sequential cognitive style. Participants subjectively assess their preferences by selecting the statements that best describe their typical learning tendencies. If a respondent agrees with more than half of the items associated with the Global style, they are classified as Global learners; if they agree with more than half of the Sequential items, they are categorized as Sequential learners. Mampadi et al. (2011) reported a reliability coefficient of $\alpha = 0.67$, indicating that the SPQ demonstrates adequate reliability for distinguishing between these cognitive styles.

3.3 Data Analytical Methods

This study employed IBM SPSS 26 for data analysis. In the first stage of data processing, it was confirmed that the financial literacy assessment and each dimension of the MSLQ contained 21 valid cases with no missing values.

In the second stage, a Shapiro-Wilk test was conducted to examine the normality of the dataset. The results indicated that the financial literacy assessment and all dimensions of the MSLQ had p-values greater than 0.05, suggesting that the data followed a normal distribution and were suitable for parametric statistical analysis. Based on these findings, the study employed the following statistical tests:

1. One-Sample T-Test to verify the effectiveness of the PBL curriculum on financial literacy assessment scores.
2. Independent-Samples T-Test to examine the influence of cognitive styles on learning outcomes.
3. Paired-Samples T-Test to assess psychological changes related to learning motivation.

This analytical approach ensures a comprehensive evaluation of the impact of PBL, cognitive styles, and psychological factors on financial literacy learning outcomes.

4. Results and Discussion

4.1 Descriptive Statistics of Participants

Table 1 presents the descriptive statistics of the study participants, categorized by cognitive style (Global vs. Sequential) and grouped by gender and academic background. The total sample consists of 21 students, with 12 classified as Global learners and 9 as Sequential learners.

Table 1: Comparative Analysis of Participant Characteristics in Project-based Learning (PBL) Courses

Panel A: Group by Gender				
	Global		**Sequential**	
	N	N%	N	N%
Female	2	16.67%	2	22.22%
Male	10	83.33%	7	77.78%
Total	12	100%	9	100%
Panel B: Group by Background				
Background	**Global**		**Sequential**	
	N	N%	N	N%
Commerce and Management	6	50%	4	44.44%
Electrical and Electronic	6	50%	5	55.56%
Total	12	100%	9	100%

Panel A summarizes the gender distribution of the participants. Among Global learners, 83.33% (N = 10) are male, and 16.67% (N = 2) are female. In the Sequential group, 77.78% (N = 7) are male, while 22.22% (N = 2) are female.

Panel B classifies participants based on their academic disciplines. In the Global group, students are evenly distributed between Commerce and Management (50.00%, N = 6) and Electrical and Electronic (50.00%, N = 6). In the Sequential group, 44.44% (N = 4) are from Commerce and Management, while 55.56% (N = 5) are from Electrical and Electronic.

4.2 Baseline Comparison of Financial Literacy and Learning Motivation

Table 2 presents the descriptive statistics and inferential test results comparing financial literacy pre-test scores between Global and Sequential cognitive style groups. In Panel A, the Global group (N = 12) had a mean pre-test score of 27.50 with a standard deviation (SD) of 9.170, while the Sequential group (N = 9) had a lower mean score of 22.78 with an SD of 5.652. The standard error of the mean (SE Mean) was 2.647 for Global learners and 1.884 for Sequential learners, indicating some variation in score dispersion across the two groups.

Table 2: Financial Literacy Pre-Test – Cognitive Style Comparison

Panel A: Descriptive Statistics by Cognitive Style				
Cognitive Style	N	Mean	SD	SE Mean
Global	12	27.50	9.170	2.64
Sequential	9	22.78	5.652	1.884

Panel B: Levene's Test & T-Test			
Levene's Test for Equality of Variances		**t-Test for Equality of Means**	
F	*p*	*t*	*p*
2.507	.130	1.359	.190

In Panel B, Levene's test for equality of variances resulted in F = 2.507, p = .130, suggesting that the assumption of equal variances was not violated (p > .05). Consequently, an independent samples t-test assuming equal variances was conducted, yielding a t-value of 1.359 and a p-value of .190, indicating that the difference in financial literacy pre-test scores between the two cognitive style groups was not statistically significant. Although the Global group had a higher mean score than the Sequential group, the results suggest that prior financial literacy levels were comparable between the two groups before the PBL intervention.

Additionally, no significant differences were found in the six psychological motivation variables measured by the MSLQ (Intrinsic Motivation, Extrinsic Motivation, Work Values, Control Beliefs, Self-Efficacy, and Learning Anxiety) suggesting that both groups had comparable baseline conditions. This indicates that the group allocation was well-balanced.

4.3 Effectiveness of PBL on Financial Literacy Improvement

Table 3 presents the results of a one-sample t-test examining whether students' financial literacy improvement rate was statistically significant after participating in the project-based learning (PBL) strategy. The analysis was conducted using the

improvement rate (%) of financial literacy scores among all participants (N = 21). The results indicate that the mean improvement rate was 49.901% (SD = 75.348%), with a t-value of 2.609 (p = .017). Since the p-value is below the .05 significance threshold, the findings suggest that students' financial literacy improved significantly as a result of the project-based learning strategy. This provides empirical support for the effectiveness of PBL in enhancing students' financial literacy learning outcomes, as the improvement rate was statistically significant across the sample.

Table 3: One-Sample t-Test for Financial Literacy Improvement Rate

Sample	**N**	**Mean (%)**	**SD (%)**	***t***
PBL Participants	21	49.901	75.348	2.609*

*p<.05

4.4 Impact of Cognitive Style on Financial Literacy Improvement

Table 4 presents the descriptive statistics and independent samples t-test results examining whether financial literacy improvement rates (%) differed between students with Global and Sequential cognitive styles.

Table 4: Independent Samples t-Test for Financial Literacy Improvement Rate by Cognitive Style

Panel A: Descriptive Statistics by Cognitive Style				
Cognitive Style	N	Mean(%)	SD(%)	SE Mean(%)
Global	12	33.827	74.160	21.408
Sequential	9	55.000	79.642	26.547

Panel B: Levene's Test & T-Test			
Levene's Test for Equality of Variances		**t-Test for Equality of Means**	
F	*p*	*t*	*p*
0.159	.694	-0.628	.538

In Panel A, the Global group (N = 12) had a mean improvement rate of 33.827% (SD = 74.160%), while the Sequential group (N = 9) had a mean improvement rate of 55.000% (SD = 79.642%). The standard error of the mean (SE Mean) was 21.408% for Global learners and 26.547% for Sequential learners, indicating some variability in the data across both groups.

In Panel B, Levene's test for equality of variances resulted in F = 0.159, p = .694,

suggesting that the assumption of equal variances was not violated ($p > .05$). The independent samples t-test yielded a t-value of -0.628 and a p-value of .538, indicating that the difference in financial literacy improvement rates between Global and Sequential learners was not statistically significant. These results suggest that cognitive style (Global vs. Sequential) did not have a significant impact on the financial literacy improvement rate following the project-based learning strategy.

4.5 Changes in Learning Motivation After PBL

Table 5 presents the results of a paired-samples t-test examining changes in learning motivation before and after the financial literacy course using a Project-Based Learning (PBL) strategy, measured using the Motivated Strategies for Learning Questionnaire (MSLQ).

Table 5: Paired-Samples t-Test for Changes in Learning Motivation (MSLQ Pre-Test vs. Post-Test)

Learning Motivation Constructs	N	Mean	SD	*df*	t	*p*
Intrinsic Motivation	21	0.333	1.041	20	1.468	.158
Extrinsic Motivation	21	0.393	1.219	20	1.477	.155
Work Values	21	0.079	1.043	20	0.347	.732
Control Beliefs	21	0.381	1.123	20	1.555	.136
Self-Efficacy	21	0.565	1.055	20	2.454	.023*
Learning Anxiety	21	-0.181	1.336	20	-0.621	.542

**p<.05*

The analysis included six learning motivation constructs: Intrinsic Motivation, Extrinsic Motivation, Work Values, Control Beliefs, Self-Efficacy, and Learning Anxiety. The results indicate that Self-Efficacy showed a statistically significant improvement after the course ($t = 2.454$, $p = .023$), suggesting that students gained greater confidence in their ability to apply financial knowledge effectively. However, no significant changes were observed in Intrinsic Motivation ($t = 1.468$, $p = .158$), Extrinsic Motivation ($t = 1.477$, $p = .155$), Work Values ($t = 0.347$, $p = .732$), Control Beliefs ($t = 1.555$, $p = .136$), or Learning Anxiety ($t = -0.621$, $p = .542$).

These findings indicate that while the PBL strategy in financial literacy education significantly enhanced students' self-efficacy, it did not lead to statistically significant changes in other learning motivation constructs.

4.6 Differences in Learning Motivation Changes Between Cognitive Styles

Table 6 presents the comparative analysis of learning motivation improvements across Global and Sequential cognitive styles, using Independent-Samples t-Tests to examine whether there were statistically significant differences in learning motivation changes after the Project-Based Learning (PBL) strategy in financial literacy education.

Table 6: Comparative Analysis of Learning Motivation by Cognitive Style

Panel A: Descriptive Statistics by Cognitive Style					
MSLQ Learning Motivation Constructs	Cognitive Style	N	Mean	SD	SE Mean
Intrinsic Motivation	Global	12	0.563	1.168	0.337
	Sequential	9	0.028	0.805	0.268
Extrinsic Motivation	Global	12	0.604	1.363	0.393
	Sequential	9	0.111	1.001	0.334
Work Values	Global	12	0.279	1.193	0.344
	Sequential	9	-0.188	0.787	0.262
Control Beliefs	Global	12	0.813	1.168	0.337
	Sequential	9	-0.194	0.788	0.263
Self-Efficacy	Global	12	0.718	1.314	0.379
	Sequential	9	0.361	0.569	0.190
Learning Anxiety	Global	12	-0.183	1.659	0.479
	Sequential	9	-0.178	0.821	0.274

Panel B: Levene's Test & t-Test		
MSLQ Learning Motivation Constructs	Levene's Test (*F, p*)	t-Test (*t, p*)
Intrinsic Motivation	1.791 (.197)	1.176 (.254)
Extrinsic Motivation	1.121 (.303)	0.914 (.372)
Work Values	0.461 (.505)	1.017 (.322)
Control Beliefs	1.849 (.190)	2.226 (.038)*
Self-Efficacy	6.739 (.018)*	0.758 (.458)
Learning Anxiety	3.034 (.098)	-0.009 (.993)

**p<.05*

In Panel A, the descriptive statistics for the six MSLQ learning motivation constructs indicate that Global learners (N = 12) generally showed greater mean improvement across most constructs compared to Sequential learners (N = 9). For example, the mean improvement in Control Beliefs was 0.813 (SD = 1.168, SE = 0.337) for Global learners, whereas it was -0.194 (SD = 0.788, SE = 0.263) for Sequential learners. Similarly, Self-Efficacy increased by 0.718 for Global learners, compared to 0.361 for Sequential learners. However, Learning Anxiety showed minimal change in both groups (-0.183 vs. -0.178, respectively).

In Panel B, the results of Levene's Test for Equality of Variances confirm that the equal variance assumption was met for most variables ($p > .05$), except for Self-Efficacy ($F = 6.739$, $p = .018$). The Independent-Samples t-test further indicates that among the six learning motivation constructs, only Control Beliefs showed a statistically significant difference between Global and Sequential learners ($t = 2.226$, $p = .038$). This suggests that students with a Global cognitive style exhibited a greater increase in Control Beliefs after the PBL-based financial literacy course, compared to their Sequential counterparts. No statistically significant differences were observed in Intrinsic Motivation ($t = 1.176$, $p = .254$), Extrinsic Motivation ($t = 0.914$, $p = .372$), Work Values ($t = 1.017$, $p = .322$), Self-Efficacy ($t = 0.758$, $p = .458$), or Learning Anxiety ($t = -0.009$, $p = .993$).

These results indicate that while PBL was generally effective in improving students' learning motivation, the impact on Control Beliefs was significantly different between Global and Sequential learners, with Global learners demonstrating greater improvement in their perceived sense of control over learning outcomes.

4.7 Cognitive Style Differences in Control Beliefs Improvement

Table 7 presents the paired-samples t-test results for examining changes in Control Beliefs before and after participation in the project-based learning (PBL) strategy for financial literacy, categorized by Global and Sequential cognitive styles. This analysis assesses whether students with different cognitive styles exhibited significant improvements in their perceived sense of control over learning outcomes. The results indicate that Global learners ($N = 12$) had a mean improvement of 0.813 ($SD = 1.168$) in Control Beliefs, while Sequential learners ($N = 9$) showed a mean change of -0.194 ($SD = 0.788$). The paired-samples t-test for Global learners yielded a statistically significant result ($t = 2.409$, $p = .035$, $df = 11$, $p < .05$), indicating that students with a Global cognitive style experienced a significant increase in Control Beliefs after participating in the PBL strategy. In contrast, for Sequential learners, the mean difference was not statistically significant ($t = -0.740$, $p = .480$, $df = 8$, $p > .05$), suggesting that their Control Beliefs did not show a meaningful change following participation in the project-based learning strategy.

Table 7: Paired-Samples t-Test for Changes in Control Beliefs by Cognitive Style (Pre-Test vs. Post-Test)

Cognitive Style	N	Mean	SD	*df*	t	*p*
Global	12	0.813	1.168	11	2.409*	.035
Sequential	9	-0.194	0.788	8	-0.740	.480

**p<.05*

As illustrated in Figure 2, the boxplot analysis provides a visual representation of the distribution of Control Beliefs improvement across both cognitive style groups.

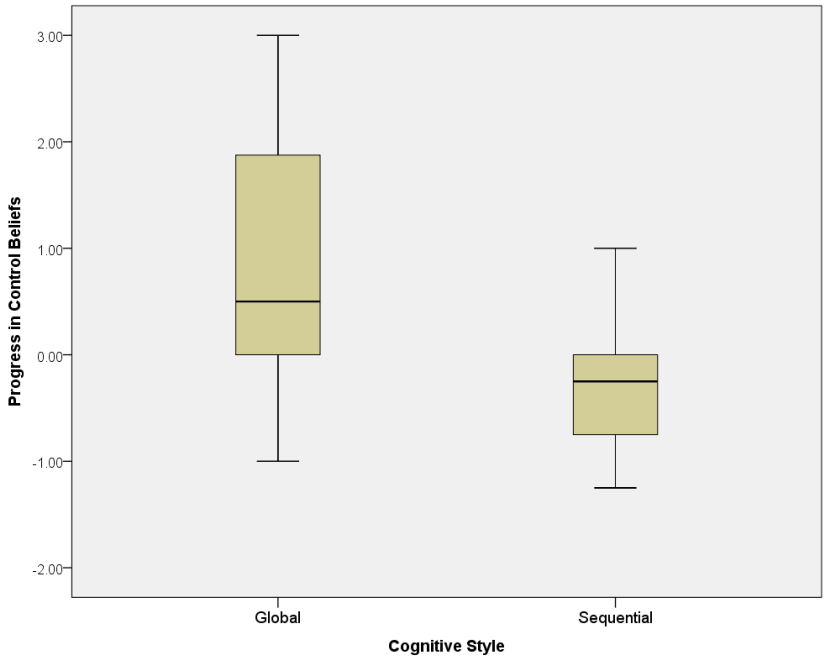

Figure 2: Boxplot of Control Beliefs Improvement by Cognitive Style (Pre-Test vs. Post-Test)

The figure highlights that Global learners exhibited greater variability and overall improvement, whereas Sequential learners showed a more constrained range of changes, with some participants even experiencing a decline in Control Beliefs. The differences in distribution patterns reinforce the statistical findings that the PBL strategy had a more substantial impact on Control Beliefs for Global learners than for Sequential learners.

5. Conclusion

This study investigated the effectiveness of a project-based learning (PBL) strategy in financial literacy education, focusing on its impact on students' learning outcomes and motivation while considering differences in Global vs. Sequential cognitive styles. The findings provide valuable insights into the role of cognitive styles in shaping financial literacy learning experiences.

The descriptive statistics in Table 1 confirmed that the Global and Sequential groups were well-balanced in terms of gender and academic background, ensuring the validity of subsequent comparisons. Table 2 further supported this by demonstrating that there were no significant pre-test differences between the two cognitive style groups in financial literacy and learning motivation constructs, indicating comparable baseline conditions.

Through a one-sample t-test (Table 3), the study found that students' financial literacy improvement rates were statistically significant ($t = 2.609$, $p = .017$), suggesting that the PBL strategy effectively enhanced financial literacy learning outcomes. However, when examining whether cognitive style influenced financial literacy improvement (Table 4), the results indicated no significant difference between Global and Sequential learners ($t = -0.628$, $p = .538$), suggesting that the PBL strategy was equally beneficial for both cognitive styles in improving financial literacy knowledge.

To explore the impact of PBL on learning motivation, a paired-samples t-test was conducted (Table 5) to compare pre-test and post-test scores across Intrinsic Motivation, Extrinsic Motivation, Work Values, Control Beliefs, Self-Efficacy, and Learning Anxiety. Among these factors, only Self-Efficacy showed a significant increase after PBL participation ($t = 2.454$, $p = .023$), highlighting those students felt more confident in their ability to apply financial knowledge after the PBL experience.

Further analysis using an independent samples t-test (Table 6) examined whether Global and Sequential learners exhibited different degrees of improvement in learning motivation. The results revealed that Control Beliefs was the only factor with a statistically significant difference between the two cognitive styles ($t = 2.226$, $p = .038$), indicating that Global learners experienced greater gains in their perceived ability to control their own learning compared to Sequential learners. This finding echoes the research of Chen and Chang (2016), which highlighted that learning differences exist between global learners and sequential learners. This finding was further explored in Table 7, which conducted a paired-samples t-test on Control Beliefs for each cognitive style. The results demonstrated that Global learners exhibited a significant increase in Control Beliefs after PBL participation ($t = 2.409$, $p = .035$), whereas Sequential learners showed no meaningful change ($t = -0.740$, $p = .480$). Figure 2 (Boxplot Analysis) visually reinforced this pattern, illustrating a greater distribution of improvement in Control Beliefs among Global learners compared to Sequential learners.

These findings contribute to financial literacy education and instructional design in several important ways. First, the PBL strategy proved effective in improving financial literacy learning outcomes for all students, regardless of their cognitive style. Second, while PBL enhanced self-efficacy across all learners, it had a more pronounced effect on Control Beliefs among Global learners, suggesting that students who process information holistically may benefit more from self-directed and inquiry-based learning approaches.

This aligns with the research of Chen and Chang (2014), Hsieh and Chen (2016), and Chen and Tseng (2019). Global learners, who can easily adapt to the structure of available resources and focus on key information, contrast with sequential learners, who prefer a more structured approach and favor resources organized in a step-by-step sequence. Therefore, teachers should offer tailored guidance for sequential learners, including clearer organization of learning materials and more scaffolded feedback, to help them navigate the learning process effectively. These

insights provide practical implications for educators, emphasizing the importance of considering cognitive style differences when implementing experiential and project-based learning strategies in financial literacy education.
Moreover, the results of this study not only fill a gap in the application of the PBL strategy in financial literacy education but also offer new research directions in the fields of digital learning technologies and AI education applications. Specifically, future research could explore how generative AI (GAI) can assist learning by providing personalized support tailored to different learning styles, thereby further enhancing learning outcomes and enriching the overall learning experience.

ACKNOWLEDGEMENTS.
This work was supported by the National Science and Technology Council, Taiwan, R.O.C [grant numbers NSTC 113-2410-H-602-001 and NSTC 111-2410-H-602-002]. I would like to express my sincere gratitude to the anonymous reviewers for their valuable feedback and to the editorial team for their assistance in the preparation of this manuscript.

Institutional Review Board Statement
The study was conducted in accordance with the Declaration of Helsinki and was approved by the Institutional Review Board (or Ethics Committee) of National Cheng Kung University (Ethics Approval No. NCKU HREC-E-111-036-2, 16 December 2022).

Informed Consent Statement
All participants in this study provided informed consent prior to their involvement.

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