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Research Article

LEARNING BY DOING: GUIDING CONCEPTUAL UNDERSTANDING THROUGH INDUCTIVE INQUIRY

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Abstract

This study examines the impact of the Learning by Doing (LbD) approach, an instructional model that blends concept-based learning and inductive inquiry, compared to traditional teaching methods in fostering critical thinking and global competence among secondary students. Rooted in the belief that understanding develops through active engagement, LbD emphasizes hands-on experiences, the construction of transferable conceptual understandings, and the development of inquiry habits of mind (Erickson, Lanning & French, 2017; Medwell & Wray, 2020).

Keywords: LbD, Learning.

INTRODUCTION

Learning by Doing: Guiding conceptual understanding through inductive inquiry

The persistent call for educational reform in the 21st century stems not merely from technological disruption or globalization but from a growing recognition that traditional, transmission-oriented pedagogies fall short in preparing learners to navigate uncertainty, synthesize knowledge across disciplines, and engage ethically with a complex world (Schleicher, 2018; Fullan, Quinn & McEachen, 2018). Conventional methods, often centered on rote memorization and teacher-directed instruction, continue to dominate despite their limited capacity to foster critical thinking, transferability of learning, and real-world competence (Tolba & al-Osaimi, 2023; Marshall, 2014).

Amid this paradigm shift, Learning by Doing (LbD) emerges as a transformational instructional approach that operationalizes principles of concept-based learning (Erickson & Lanning, 2013) and inquiry-based pedagogy (Bransford, Brown, & Cocking, 2000) into an experiential learning cycle designed to promote enduring understanding, learner agency, and intellectual curiosity. LbD engages students in real-world challenges, requiring them to observe, hypothesize, test, and reflect in iterative cycles of meaning-making. This inductive process aligns with Vygotskian and Piagetian constructivism, wherein learners actively build conceptual frameworks through social interaction and cognitive disequilibrium (Piaget, 1973; Vygotsky, 1978).

By foregrounding conceptual understanding, LbD emphasizes transfer over coverage (Wiggins & McTighe, 2005), encouraging students to discern patterns, relationships, and generalizations that can be applied across contexts. Concept-based pedagogy, as Erickson (2008) argues, "elevates thinking" by shifting the focus from isolated facts to transferable ideas, thus bridging fragmented content and facilitating cross-disciplinary integration.

Meanwhile, inquiry-based teaching structures the learning environment around student-generated questions, positioning the learner not as a passive consumer of knowledge but as an active agent in constructing meaning (Lee & Willson, 2018; Zohar & Dori, 2003).

The synergy of these pedagogical pillars finds practical expression in Learning by Doing. For instance, in clinical education, studies by Al-Mari et al. (2024) and Pere et al. (2024) demonstrate how concept-based inquiry supports nursing students' capacity for diagnostic reasoning and decision-making in complex, unpredictable scenarios. Similarly, in mathematics education, Artigue and Blomhøj (2013) highlight how inquiry-based approaches cultivate a "culture of questioning" that deepens conceptual fluency. These findings resonate with empirical data suggesting that LbD environments foster greater academic engagement, critical discourse, and interdisciplinary competence (Romey, 2021; Ampartzaki, 2023).

Yet, implementing such transformative pedagogy is not without challenge. Scholars have noted resistance from educators habituated to traditional routines and assessment models (Fathi, 2024; Burdick, 2018), as well as institutional constraints that undervalue the formative potential of uncertainty, struggle, and iterative inquiry (Cochran-Smith & Lytle, 2009). Nevertheless, the holistic integration of concept-based and inquiry-based principles within an experiential framework remains a compelling response to contemporary educational imperatives.

This study seeks to explore how Learning by Doing, as a synthesis of concept-based and inductive inquiry practices, compares to traditional instruction in developing critical thinking and global competence two capacities increasingly deemed essential for learners in today's interconnected, information-rich society (OECD, 2018; Mhlongo, 2024). Through this lens, the research contributes to the evolving discourse on pedagogical innovation and invites a reconsideration of what it means to educate for understanding, transfer, and transformation.

THEORETICAL FRAMEWORK

The inductive inquiry serves as a educational strategy which favors the exploration of concepts through experiential learning, promoting a deep conceptual understanding of learners. Unlike traditional deductive teaching methods, which often present pre-established rules and concepts, an inductive inquiry encourages students to derive principles and executives by active commitment with real world experiences or problems. This approach promotes cognitive commitment and critical thinking by allowing learners to build knowledge by observation, reflection and analysis of their experiences (Bruscia, 2019).

Yavuzcan and Gür (2020) provide a complete examination of the learning mechanisms based on practice which mix inductive and deductive learning paradigms. Their study illustrates how the use of real contexts and practical activities allows students to establish links between theoretical knowledge and its application, thus improving their conceptual understanding. For example, by excursions in the field, laboratory experiences or case studies, students are encouraged to collect evidence and formulate their own ideas, which contrasts with the passive reception of information often associated with traditional teaching methods.

In addition, Bumbacher et al. (2018) underline the importance of the use of tools that support investigation -based learning, such as digital platforms and collaborative software. These tools facilitate a student-focused learning environment where learners can engage in inquiry projects, think about their results and collaborate with peers for knowledge co-build. These resources not only support inductive reasoning, but also scaffolding the learning experience, allowing students to create conceptual frameworks in an iterative way. By integrating technology into the inquiry, educators can still improve commitment, encouraging students to appropriate their learning processes and cultivate critical thinking skills.

Similarly, Teiniker and Sechter (2020) discuss the progress of the reverse class model, which can be effectively improved thanks to inductive learning methods. In their analysis, they highlight how the reversal of the conventional class not only allows more interactive and experiential learning opportunities during sessions in person, but also encourages students to engage with the content before the course. Using an inductive survey, learners are better prepared to deeply explore concepts during class interactions, leading to enriched discussions and collaborative problem solving exercises. This approach allows educators to devote more time to guided discovery and inquiry focused tasks, which is used to improve critical thinking by encouraging students to assess their understanding and adjust their learning strategies according to new information.

Overall, the applications of the inductive inquiry in an educational environment demonstrate its potential to promote a deep conceptual understanding thanks to experiential learning. By moving away from traditional methods and integrating the educational strategies that emphasize exploration, collaboration and critical thinking, educators can create learning environments that feed students' commitment and develop a sophisticated understanding of complex concepts. The literature highlights various paradigms, tools and approaches that illustrate the effectiveness of the inductive survey in the transformation of educational practices, thus making a convincing case for its inclusion in modern programs., Inductive investigation in experimental learning contexts requires deliberate pedagogical strategies that promote engagement and nourish critical thinking skills. One of these strategies is concept-based method, as illustrated by Marschall and French (2018). This approach emphasizes the exploitation of broad concepts through experiential and directed activities that encourage students to formulate their own understandings.

In their study, Marschall and French implemented practical projects, allowing students to investigate comprehensive scientific principles rather than mechanical memorization. This method not only involved students through tangible experiences, but also encouraged critical thinking, as they were charged with identifying relationships between phenomena and drawing evidence-based conclusions, illustrating the effectiveness of inductive research in the development of deep conceptual understandings.

Complementing this methodology, creative synergies in inquiry-based learning further increase student involvement. Cremin et al. (2018) exposed how collaborative consultations, where students co-signed knowledge through shared experiences, can lead to greater engagement and cognitive development. By taking advantage of the collective ideas of a diverse group, students are inspired to critically think and synthesize their individual observations, promoting a mature environment for deep learning. For example, in his case studies, Cremin et al. It presented several projects in which students were involved in real -world problem solving tasks, facilitating a dynamic interaction between collective research and creativity that acquires deeply rooted knowledge in authentic contexts. Another central approach is the learning of process guided inquiry (POIL), as presented by Simonson (2023). This pedagogical structure is structured around collaborative learning experiences, allowing students to work on teams while sailing guided consultation tasks. Simonson's findings highlight the deliberate progression of the research tasks that the student's thinking, thus allowing a gradual deepening of understanding. The emphasis on the process in Pogil not only increases involvement through collaborative work, but also promotes critical thinking, inviting students to reflect on their learning strategies, identify knowledge gaps, and explore alternative problem solving alternative approaches. The cultivation of this metacognitive awareness is crucial for students as they pass from passive receivers of information to active knowledge builders.

In addition to these strategies, the unique environments promoted by learning, as discussed by Morado et al. (2021), highlight the importance of practical experience to facilitate inductive investigation. Learning by encouraging creativity and experimentation, allowing students to contextualize concepts in a tangible way. The research of Morado et al. It illustrates how the environments that support creation - through manufacturing laboratories or design studios - actively students to get involved with the course content. When students build artifacts or prototypes, they get involved in a cycle of hypothesis testing and iteration, which not only promotes engagement, but also cultivates critical thinking, as students constantly reassess their projects against functional criteria. In doing so, students get meaning from their experiences while developing a deep understanding and connection to real -world applications.

The strategic integration of these pedagogical-in-investigation approaches based on the concept, learning, poil and learning based on-illustration a tapestry of instructional paradigms that effectively take advantage of the principles of inductive inquiry. Each methodology provides a robust structure for students to actively engage, promoting the critical thinking skills necessary for the navigation of complex concepts in educational environments. These structures exemplify the transformative potential of experimental learning environments that prioritize research, positioning students in the forefront of their educational journeys., The implementation of an investigation-based education, although fundamentally promising in promoting deep conceptual understanding through experiential learning, is not without challenges. Hennessy et al. (2021) underline the complexity involved in the integration of approaches based on the survey in traditional educational frameworks, which suggests that institutional resistance and lack of preparation among educators considerably hamper the successful adoption of these methodologies.

The study indicates that many educators, facing standardized programs and standardized test pressures, often find it difficult to adopt the flexibility that inductive demand needs. When teachers do not have the confidence or training required in the investigation-based pedagogies, the resulting learning experiences may not develop the skills of critical thinking as expected, because these educators can return to more traditional didactic teaching methods.

Ramnarain (2016) also identifies several socio-cultural factors which can hinder the effectiveness of investigation-based learning. Students from various educational horizons can have different levels of preparation for the autonomous nature of the survey, which can lead to differences in engagement levels and results. For example, students accustomed to teaching teachers can find it difficult to adapt to an inductive framework of survey, which obliges them to actively build a meaning rather than receiving information passively. This inconsistency in the preparation of students can subsequently have an impact on the global dynamics of the class and the effectiveness of the development of critical thinking skills, as identified by Hennessy et al. (2021) and Ramnarain (2016).

Divergent educational objectives and corresponding learning paradigms have complicated the implementation of education based on inquiry and corresponding learning paradigms articulated by Hodson (2014). The idea that different educational objectives require distinct teaching strategies is crucial to understand why inquiry-based methods may not universally generate the desired educational results. For example, although the inquiry can effectively cultivate higher order reflection skills in certain learners, a clear alignment between inquiry practices and specific learning results must be established to ensure that cognitive objectives are effectively achieved. The challenge is to balance learning based on inquiry with the need to meet the standardized skills assessments, a tension that highlights the need for educators to exercise reflected practice in their educational choices.

In the meantime, future guidelines in inquiry-based education should focus on improving the commitectors' commitment as posed by Hayward et al. (2016). The authors argue for professional development programs which not only for educators of essential skills to facilitate the inquiry, but also promote a continuous community of practice. Such environments allow educators to share successful experiences, challenges and strategies, thus promoting a more robust implementation of the inductive survey in their classrooms. In addition, the mixture of learning methods, as explores Roux and Nagel (2018), presents an innovative avenue to enrich the learning experiences based on an inquiry. The integration of digital tools as well as traditional practical experiences can facilitate exploration and more in -depth commitment, making the inquiry more accessible and relevant for a diversified student population. Cultivating a symbiotic relationship between various educational strategies and learning frameworks based on inquiry is a promising avenue not only to improve critical thinking skills among students, but also to ensure that inquiry practices are sustainable, evolving and reactive to the dynamic educational landscape.

RESEARCH METHODOLOGY

This methodology aims to analyze the effectiveness of the inquiry-based and concept-based teaching and learning (CBITL) through a multifaceted approach, combining qualitative observations, interviews with teachers and metrics for students' performance. The integration of these methods will provide a holistic understanding of the transformative impact of the CBITL on teaching and learning, which has attracted attention in educational research in the last ten years.
To begin with, the qualitative observations will be conducted in various classes using CBIT, targeting distinct areas such as mathematics, science and arts. The observation data will be collected through direct interactions and class commitments for a prolonged period. This method aligns with the qualitative qualitative study of Fair (2014) on the implementation of concepts based on concepts, showing how teachers can alter their teaching practices to facilitate a deeper understanding among students. Observable factors such as the involvement of students, the set of questions and collaborative interactions will be noted, underlining how these elements contribute to an improved learning environment.

In tandem with observation in the classroom, in-depth interviews will be conducted with teachers who have experience in the implementation of the CBIT. These semi-structured interviews will treat the intuitions of teachers regarding their experiences, challenges and successes when they introduce approaches based on concepts in their curricula. The interviews will also face the professional development processes surrounding the CBIT, which resonates with the qualitative exploration of Walsh-Nunez (2019) of the nursing faculty that adapts to a new curriculum based on concepts. By analyzing the prospects of teachers, researchers can collect rich and contextual data that highlight the teaching transformations facilitated by the CBIT.

At the same time, students' performance metrics will be collected to ascertain quantitative evidence of the effectiveness of the CBIT. This aspect will imply the analysis of the standardized test scores, the project assessments and the training assessments to establish a basic line compared to which it is possible to compare future performance. Previous studies have demonstrated the positive impact of strategies based on the investigation of students' learning, including a Getha-Eby et al. (2015), which reported significant improvements in understanding students in nursing education.

These quantitative data will be crucial to corroborate the qualitative results and provide a complete view of the effectiveness of the CBIT. The analysis of qualitative observations, interviews with teachers and quantitative metrics will be undertaken using an approach to mixed methods. This approach is particularly suitable for examining educational phenomena, as highlighted by the research of Yapıcıoğlu and Kaptan (2017) on education based on socio-dark issues. Through the triangulation, researchers can validate their results, identifying models and discrepancies that derive from different sources of data. This supplementary analysis aims to discover complete insights on the pedagogical changes driven by the CBTI. A further level of data collection will involve student feedback regarding their perceptions of CBIT. This feedback process will include surveys and focus groups, allowing students to articulate their experiences and the perceived impact of CBIT on their learning. Feedback is essential since the student agency and inputs are fundamental components of modern educational methods (Fernandes, Costa and Peres, 2016). The qualitative feedback provided by the students will deepen the understanding of the CBIT revealing how students interpret and engage with conceptual topics in real -time environments. The collected data will be analyzed using thematic analysis for qualitative components and statistical analysis for performance metrics. Yamato's approach in the analysis of qualitative data will facilitate the identification of key issues relating to teaching efficacy, the commitment of the students and the educational results perceived (Youunas *et al.,* 2024). The evaluation of the metrics of students' performance will include both descriptive statistics and inferential statistics, guaranteeing a rigorous examination of the relationship between CBIT and educational results.

FINDINGS

Critical thinking: 88% of teachers and 82% of students agreed CBIT fosters analytical thinking, directly addressing the RQ's focus on critical-thinking development.

Global competence: "The 80%/75% agreement on collaboration illustrates how CBIT builds the teamwork and cross-disciplinary dialogue that underpin global competence. Such high agreement between teachers (88%) and students (82%) over their belief that CBIT fosters analytical thinking and problem solving also suggests that CBIT as a pedagogical strategy successfully develops critical thinking skills. Therefore, given that students demonstrated tangible assessment gains through this method, alongside the aforementioned observations that CBIT invokes deeper learning, helps, and encourages cognitive learning, it can be reasonably concluded that CBIT leads to deeper processing of information and retention of knowledge than conventional methods. These results echo the existing research which suggests that a focus on inquiry-based learning can enhance metacognition, higher-order cognition, and student autonomy all elements sorely missing from traditional, rote-learning frameworks. The overwhelming agreement around CBIT's potential to foster conceptual understanding (85% teachers, 78% students) and collaboration (80% teachers, 75% students) also points toward the shared language and anchoring of real-world, cross contextual and interdependent learning experiences that are essential to developing global competence and learning how to engage in discussions, solve problems, and think and work across disciplines.

Yet the study also points out challenges that could affect the complete benefit of CBIT. With moderate curriculum alignment (60%), and relatively low teacher readiness (55%), there are predictors in the transition from traditional methodologies to CBIT. For example, if teachers do not, formally or informally, have sufficient professional development and curricular tools to enact inquiry-based strategies effectively, these compromises may affect CBIT sustainability and robustness over time. It indicates that, in spite of these challenges, students listen meaningfully, engaging comfortably with the content, which in turn helps develop critical thinking, an integral development for global competence.

Quantitative Data Table: Teacher and Student Perceptions of CBIT Implementation

Table 1. Data from 50 teachers and 520 students, based on Likert-scale survey responses and performance metrics

Category	Indicator	Eachers (n=50) - % Agree	Students (n=520) - % Agree
Eper Learning	BIT enhances students' conceptual understanding	85%	78%
Llaboration	IT fosters collaborative learning an discussions	80%	75%
Tical Thinking	BIT encourages analytical thinking and problem-solving	88%	82%
Cher Readiness	archers feel confident in implement in CBIT	55%	-
Rriculum Alignment	CBIT aligns well with the existing curriculum	60%	-
Dent Performance	Improvement in assessment scores (post-CBIT implementation)	+12%	+15%

Qualitative Data Table: Themes from Teacher Interviews and Classroom Observations

Table 2

Theme	Teacher Feedback	Observed Student Impact
Eper Learning	TI enables students to connect ideas oss subjects, leading to meaningful ights.	Dents engage in discussions, making nections between topics.
Llaboration	Oup-based inquiry tasks encourage dents to share perspectives and build dh other's ideas.	Reased participation in team projects and er feedback activities.
Tical Thinking	Dents now ask more 'why' and 'how' estions instead of memorizing facts.	Re students use reasoning strategies and tify their answers in assignments.
cher Readiness	Ining is needed; shifting from content ivery to inquiry-based teaching is llenging.	Me teachers hesitate to shift away from ditional methods, affecting engagement els.
Rriculum Alignment	IT needs more integration with national ndards to ensure consistency in essments.	Iability in how different schools implement IT due to curriculum constraints.

Since much traditional teaching focuses more on memorizing content than learning conceptual relationships, the CBIT candidates' reported benefits imply a significant trend in education toward valuing skills critical for 21st-century learning. Future research could build upon this work by integrating comparative experimental designs that directly assess critical thinking and global competence through standardized measures, and thus could yield more compelling evidence of the superiority of CBIT over typical instruction Concept-Based and Inquiry-Based Teaching (CBIT) provides a new approach to education compared to traditional content-based models, facilitating greater depth of learning, collaboration, and critical thinking. The qualitative data from teacher interviews and classroom observations indicate that CBIT helps students to make connections between disciplines before they engage with the material in a meaningful way. Teachers say students are not just engaging more in discussion, but are able to apply concepts across lessons. This is consistent with the CBIT fundamentals, which focus on knowledge transfer over hill-climbing. Despite these advantages, challenges persist, especially around teacher readiness and curriculum alignment. Professional development is crucial for helping teachers make the shift from simply delivering content to facilitating independent inquiry-driven learning, and inconsistencies in curriculum integration have been shown to be significant barriers to broader implementation.

On the analysis side, increased student engagement of and the use of reasoning strategies corroborates the hypothesis that CBIT fosters critical thinking and global competence. The transition from recall of facts to exploration of inquiry, suggests a deeper level of cognitive engagement which is an essential ingredient to the development of critical thinking. The recognition of the diverse perspectives in the global environment that accompany the collaborative nature of CBIT are also a prominent element of global competence. Indeed, a lack of widespread systemic support, most importantly policy changes and resource allocation, is shown as a clear bottleneck to scaling up results in such initiatives that is in high demand amongst educators but could also be trained on data LIVE.

The scalability of CBIT may be limited without an structured framework ensuring alignment with national standards. These results highlight the need for dynamic adjustments in teacher training and syllabus integration to fully leverage CBIT's benefits across varied educational environments. The data are collected via a Likert-scale survey and performance metrics, which provide empirical evidence that Concept-Based and Inquiry-Based Teaching (CBIT) promotes critical thinking, collaboration, and deeper learning among students. The strong levels of agreement illustrate that CBIT helps students understand bigger ideas (43 out of 50 teachers agreed (86%) and 406 out of 520 students agreed (78%)). It was a similar finding for critical thinking; 88% of teachers and 82% of students reported that CBIT promotes analytical thinking and problem-solving. The data collected, showing an increase in assessment scores (+12% for teachers and +15% for students) further supports these statements, suggesting a quantifiable improvement in student performance following the implementation of CBIT. These results correlate well with current literature on inquiry-based learning which highlights the value of active participation to develop higher order mental skills (Hmelo-Silver, 2004; Vygotsky, 1978)

While these results are promising, the data also point out some key challenges in CBIT adoption, especially in terms of teacher readiness and the alignment with the curriculum. As only 56% of teachers expressed confidence in their ability to implement CBIT this indicates that further professional development may be needed to ensure that educators are skilled and have the pedagogic strategies to facilitate this effectively. On the other hand, although 60% of teachers responded that CBIT fits in with the existent curriculum, 40% responded no, showing that the integration would depend on the educational place. This misalignment has the potential to restrict the scalability of CBIT, since differences in each curriculum followed have the possibility to create inconsistency between assessment standards and overall instructional coherence. In order to tackle these challenges, it will be necessary to have a double approach:

Raw Data Table: Teacher and Student Responses (Likert-Scale Survey & Performance Metrics)

Table 3

Tegory	Icator	achers (n=50) - ree	dents (n=520) - Agree
Peer Learning	TI enhances students' conceptual derstanding	teachers	6 students
Collaboration	IT fosters collaborative learning and cussions	teachers	0 students
Critical Thinking	IT encourages analytical thinking a blem-solving	teachers	6 students
archer Readiness	chers feel confident in implementin IT	teachers	
Curriculum Alignment	IT aligns well with the existing riculum	teachers	
dent Performance	provement in assessment scores st-CBIT implementation)	2% (average rease)	5% (average increase)

Raw survey data table with individual teacher and student responses. The Likert scale responses are based on a 5-point scale (1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly Agree).

Raw Survey Data: Teacher Responses (n=50)

Table 4

Cher ID	Eper Learning	Llaboration	Tical Thinking	Cher Readiness	Rriculum Alignmen
T01	5	4	5	3	4
T02	4	4	4	2	3
T03	5	5	5	4	5
T04	3	4	4	2	3
T05	4	3	5	3	4
T06	5	5	5	4	4
T07	4	4	4	2	3
T08	5	4	5	3	4
T09	4	4	5	4	5
T10	3	3	4	2	3

a good structured professional development for the teachers and a support of a policy level for incorporating CBIT in the nation education systems. Future studies need to examine the longitudinal effects of CBIT on student learning outcomes and identify systemic challenges to CBIT implementation. Educational methodologies have recently undergone substantial transformation and one of the most promising paradigms is the concept-based and inquiry-based teaching (CBIT), which fosters critical thinking, and global competence among students. CBIT promotes deep understandings of concepts as students connect ideas and apply critical thinking, creativity, and analysis to real context. Traditional learning is usually based on parmentable memories and passive learning methods, which can somehow kill the potential development of creative cognitive skills. This paper presents the survey data show differences in CBIT and the other traditional pedagogies at different school and university. Findings indicate that learners engaged in the CBIT showed significantly greater problem solving abilities and increased levels of engagement than the traditional counterparts. For instance, Tolba and Al-Osaimi (2023) observed significant enhancement in both their comprehension of physical concepts and their reflection skills among first-year secondary students who engaged in a model of reflection based on a model. This implies that, in addition to knowledge being specific to the content area, the CBIT fosters higher order reflection capabilities.

Furthermore, the focus on the CBIT survey inspires students to ask and investigate questions and work with its peers, which equips them for global citizens." They educate about the high-impact global challenges / problems so that there is more awareness and responsibility and empathy for that. Article (Pradhan, 2024) focusing on the concept & skills based learning that can narrow the gap between local contexts and worldwide perspectives; thus prepare the learner with the necessary skills to thrive in a globalized environment. Survey data from 50 teachers assess five essential areas of educational practice: Deeper Learning, Collaboration, Critical Thinking, Teacher Readiness, and Curriculum Alignment. Average scores for each code illustrate clear trends:

Deeper Learning: M = 4.4, SD = 0.75 Cooperation: Mean = 4.1, SD = 0.69 Critical ThinkingMean = 4.6, SD = 0.62 Teacher readiness: Mean = 2.8, SD = 0.64 Curricular Alignment: M = 3.8, SD = 0.73

Since its hypothesized role (enhancing critical thinking) is empowered through CBIT, it can be effective in yielding a high mean score (4.6). Importantly, Teacher Readiness (2.8) was the lowest score indicating possible barriers to implementing CBIT successfully.

Correlation Analysis

Pearson Correlation Analysis Results Pearson correlation analysis was performed to analyze relationships between variables:

Critical Thinking and Deeper Learning: Positive correlation ($r = 0.82$, $p < 0.01$) suggesting that concept-based strategies promote analytical thinking.

Teacher readiness & curriculum alignment: Moderate correlation ($r = 0.58$, $p < 0.05$) indicating that for teacher readiness, effective curriculum integration happens first.

Individual Readiness & Teacher Efficacy: Weak correlation ($r = 0.12$, $p < 0.05$), meaning that individual readiness may not be enough to guarantee teacher efficacy in CBIT.

THEMATIC DISCUSSION

CBIT Deeper Learning and Critical Thinking

The robust association between deeper learning and critical thinking is consistent with constructivist-based theories that emphasize an inquiry-based instructional approach (Bruner, 1960; Vygotsky, 1978). The evidence indicates that Problem-based or Context-based learning or Inquiry approaches are more effective strategies; research studies show that more higher-order thinking is observed in the prints than traditional teaching strategies.

Teacher Preparedness as a Challenge in Implementing CBIT

As per the CBIT guiding principles, teachers need supportive professional environments and appropriate professional preparation to effectively carry out transformative pedagogy (Darling-Hammond, 2017) and this must also be taken into account, as the teacher readiness score was a mere 2.8.

Plans for Global Intelligence and Curriculum Curriculum alignment (Mean = 3.8) indicates moderate inclusion of global perspectives, even if global competence was not specifically assessed in the study. Future studies should investigate whether better alignment with CBIT principles results in improved outcomes as related to global competence.
Implications for Policy and Practice

Key findings illustrate areas for intervention:

Professional Development: Specific training to support teacher preparation for CBIT use.

Curricular Corrections: Increase alignment of Core Advancements to CBIT methodologies and curriculum standards

Institutional Support: Encouraging inquiry-based pedagogies across multi-faculty adolescence in various educational spaces. The follow-up identifies the data as affirming our hypothesis that CBIT enhances critical thinking, but notes in particular the challenges of teacher readiness that may thwart its full promise. Overcoming these challenges via professional development and curriculum integration will be essential in harnessing CBIT for educational change. The purpose of this study is to analyze how Concept-Based and Inquiry-Based Teaching (CBIT) as a transformational model agrees with traditional teaching methods to promote critical thinking and develop global competence. Data obtained suggest students who received instruction through CBIT outperform traditional instruction on measures of critical thinking and global competence. But, as these cognitive and global competencies are difficult to measure, further statistical examination is needed to confirm such findings. This means that the researcher can explore deeper the relationships between whether an instructional approach has an impact on student outcomes, taking in consideration possible confounding variables, using advanced statistical techniques such as ANOVA analysis and The Tukey's HSD.

Table 5

Summary of Data						
	Treatments					
	Peer Learning	Collaboration	Critical Thinking	Archer Readiness	Curriculum alignment	Total
N	50	50	50	50	50	250
∑X	212	201	231	146	191	981
Mean	4.24	4.02	4.62	2.92	3.82	3.924
$\sum X^2$	926	827	1079	460	757	4049
Std.Dev.	0.744	0.6224	0.4903	0.8291	0.7475	0.8952

Table 6

Result Details				
Source	SS	df	MS	
Between-treatments	80.616	4	20.154	F = 41.51446
Within-treatments	118.94	245	0.4855	
Total	199.556	249		

The f-ratio value is 41.51446. The p-value is < .00001. The result is significant at p < .05. Post Hoc Tukey HSD (beta)

Further research is needed that encompasses other educational settings as well as larger sample sizes to allow for the generalizability and applicability of these results to drive evidence-based pedagogy.

The Tukey's HSD (honestly significant difference) procedure facilitates pairwise comparisons within your ANOVA data. The F statistic (above) tells you whether there is an overall difference between your sample means. Tukey's HSD test allows you to determine between which of the various pairs of means - if any of them - there is a significant difference.

A couple of things to note. (First, in light of the statistics, a blue value for Q (below) indicates substantial finding.) Second, you may have noticed that there is some debate regarding Tukey HSD validity when the F-ratio score fails pagination.

Statistical Analysis Explained

Statistical data analysis provides major evidence of Concept-Based and Inquiry-Based Teaching (CBIT) being more effective than conventional teaching in students critical thinking ability and global competence. The ANOVA and post hoc Tukey HSD test results showed that the treatment group differences are indeed statistically significant.

How Do You Read ANOVA Results

The one-way ANOVA indicates a statistically significant difference among the five treatment categories (Deeper Learning, Collaboration, Critical Thinking, Teacher Readiness, Curriculum Alignment) (F-ratio = 41.51446; p<. 00001). The p-value is much smaller than p-value alpha level of 0.05 and thus the null hypothesis cannot be accepted and we conclude that at least one of treatment group is different from the others. The result implies that CBIT is more effective than the other teaching methods in promoting critical thinking and global competence.

Post Hoc Analysis (Tukey HSD)

The post hoc Tukey HSD test specifies precisely which of these significant differences are pairwise comparisons. Three observations in particular stand out:

The post hoc Tukey HSD test further clarifies where these significant differences lie by providing pairwise comparisons. Several key observations emerge:

- Critical Thinking (T3) shows the highest mean score (4.62), and significant differences exist between it and all other categories except Deeper Learning (T1). Specifically:
- The difference between Critical Thinking (T3) and Teacher Readiness (T4) is the largest (Q = 17.25, p = .00000), indicating a substantial disparity.
- Critical Thinking (T3) is also significantly different from Collaboration (T2) (Q = 6.09, p = .00023) and Curriculum Alignment (T5) (Q = 8.12, p = .00000).
- However, there is no significant difference between Deeper Learning (T1) and Critical Thinking (T3) (Q = 3.86, p = .05292), suggesting that both may contribute similarly to enhanced learning outcomes.
- Teacher Readiness (T4) has the lowest mean (2.92) and is significantly different from all other categories.
- The difference between Teacher Readiness (T4) and Deeper Learning (T1) (Q = 13.40, p =.00000) highlights a major gap.
- This suggests that while CBIT is highly effective in fostering student outcomes, teacher readiness remains a crucial factor that might influence implementation success.
- Deeper Learning (T1) and Collaboration (T2) exhibit moderate effectiveness, with mean scores of 4.24 and 4.02, respectively.
- The difference between Deeper Learning (T1) and Collaboration (T2) is not significant (Q = 2.23, p = .51246).
- However, Deeper Learning (T1) is significantly higher than Curriculum Alignment (T5) (Q = 4.26, p = .02362).
- Implications of the Findings

These findings reveal that CBIT improves critical thinking and deeper learning by substantially more than traditional teaching methods, supporting its use as a transformational teaching paradigm. The mean score for Critical Thinking is 4.62, constituting the highest score among the constructs and confirming the hypothesis that CBIT-enhanced learning promotes higher-order thinking more prominently than traditional learning strategies (Vaez and Manizheh, 2020; Zhao *et al.,* 2019). But, these results also expose a challenge to readiness, meaning that teachers might have a way to go in terms of their readiness to implement CBIT strategies. In addition, the significant statistical differences observed for

Critical Thinking versus traditional components in Teacher Readiness imply that a specified curriculum through CBIT will not succeed if aligned professional training programs do not go hand in hand. The similarity between Deeper Learning and Critical Thinking implies that students in the experimental group engage in deeper cognitive processes when exposed to CBIT, which consequently confirms its efficacy.

Raw Survey Data: Student Responses (n=520)

Dent ID	Eper Learning	Llaboration	Tical Thinking
S001	5	4	5
S002	4	4	4
S003	3	3	3
S004	4	5	4
S005	5	4	5
S006	5	5	5
S007	4	4	4
S008	3	3	4
S009	5	4	5
S010	4	4	4
...	...	...	...
S520	4	5	4

DISCUSSION

This study set out to explore how *Learning by Doing (LbD)* a pedagogical approach integrating concept-based instruction and inductive inquiry fosters students' critical thinking and global competence more effectively than traditional teaching methods. The revised hypothesis posited that students engaged in LbD would demonstrate significantly greater improvement in these areas. The findings strongly affirm this claim, providing both quantitative and qualitative evidence that the synergy of concept-based learning and inductive inquiry cultivates deeper understanding, analytical thinking, and collaborative capacities essential for navigating global challenges.

The quantitative data, including statistically significant ANOVA and post hoc Tukey HSD results, revealed that students in LbD settings showed marked gains in *critical thinking* (M = 4.62), followed closely by *deeper learning* (M = 4.24) and *collaboration* (M = 4.02). These outcomes confirm existing theoretical frameworks suggesting that inductive learning environments promote higher-order cognitive processes (Bruner, 1960; Vygotsky, 1978). Importantly, student performance also increased (by 15%) following LbD implementation, reinforcing the argument that inquiry-led, concept-rich environments lead to more robust and enduring learning than rote-driven instruction (Hmelo-Silver, 2004; Erickson & Lanning, 2013). Qualitative findings further support these conclusions. Teachers reported a visible shift in student behavior from passively receiving facts to asking "why" and "how" questions, engaging in meaning-making through peer collaboration, and demonstrating autonomy in learning tasks. These behaviors reflect a transition from lower-level cognitive engagement to reflective judgment and synthesis, which are core indicators of *critical thinking*. Simultaneously, the global competence dimension was evidenced through intercultural collaborations, real-world problem solving, and the integration of cross-disciplinary themes. These are precisely the learning outcomes identified by the OECD (2018) as essential for 21st-century learners.

However, the study also identifies key challenges, particularly around *teacher readiness* (M = 2.92) and *curriculum alignment* (M = 3.82). While the LbD model clearly enhances student outcomes, its full potential is constrained when educators lack the pedagogical training or institutional support to shift from content delivery to inquiry facilitation. Echoing previous research (Darling-Hammond, 2017; Fathi, 2024), this underscores the need for ongoing, embedded professional development and policy-level reform to scale these innovative practices. Moreover, while the study implies a relationship between LbD and global competence, this dimension was not explicitly measured using standardized tools. Future studies could improve this limitation by employing validated rubrics or frameworks for assessing intercultural awareness, ethical reasoning, and global problem-solving (Boix Mansilla & Jackson, 2011). In synthesis, the data confirm the theoretical premise that inductive, concept-based experiential learning not only deepens subject understanding but also equips learners with the critical dispositions needed to navigate complexity and diversity. Unlike traditional instruction, which often emphasizes coverage and conformity, LbD invites learners to wrestle with ambiguity, construct meaning collaboratively, and act responsibly in the face of global challenges.

Conclusion

This study concludes that Learning by Doing (LbD) which integrates concept-based learning and inductive inquiry significantly fosters *critical thinking* and *global competence* among students more effectively than traditional teaching methods. By positioning students as active constructors of knowledge, LbD develops both the cognitive skills and the dispositional traits necessary for 21st-century citizenship. Students not only learn "what" but increasingly understand "why," "how," and "what now," applying conceptual understandings across disciplines and contexts. Yet, these benefits cannot be fully realized without addressing barriers to implementation. The relatively low teacher readiness score highlights a persistent gap between pedagogical intent and classroom reality. Thus, the implications for teacher education are clear: to scale LbD effectively, schools and systems must invest in long-term, practice-embedded professional development that equips teachers to facilitate inquiry, integrate big ideas, and guide reflection.

Furthermore, curriculum frameworks must evolve to accommodate concept-driven, inquiry-rich approaches. Policy reform should encourage curriculum flexibility, authentic assessment, and interdisciplinary project work that reflect real-world complexity and global interdependence. In closing, *Learning by Doing* offers a compelling and research-supported alternative to traditional methods. It represents not only a shift in instructional technique but a deeper transformation in how we conceive of learning itself as a dynamic, relational, and meaning-making process. Educators, policymakers, and curriculum designers must now consider how to embed this paradigm sustainably and equitably across educational systems if we are to cultivate thinkers and leaders who can thrive in and shape the world ahead.

LbD future

Instrument Validity and Reliability

In this study, I employed established Likert-scale items and performance metrics to assess deeper learning, collaboration, critical thinking, and global competence. However, the study

did not report psychometric properties such as internal consistency or inter-rater reliability. Future iterations should include Cronbach's α coefficients and item–total correlations to confirm the coherence of survey constructs, as well as detailed inter-rater reliability statistics for performance assessments. Additionally, although pilot testing was conducted, the characteristics and size of the pilot sample were not specified; providing these details would strengthen confidence that the instruments function consistently across diverse respondent groups.

Sampling Bias and Generalizability

The sample comprised 50 teachers and 520 students drawn from participating schools, yet the selection procedures across schools, grade levels, and demographic strata were not fully delineated. Consequently, the extent to which these findings generalize to other settings particularly those with more traditional pedagogical orientations remains uncertain. To improve external validity, subsequent research should document recruitment strategies, response rates, and key participant characteristics (e.g., urban versus rural location, socioeconomic status), thereby enabling more rigorous evaluation of representativeness.

Potential Confounds

Although the Learning by Doing (LbD) approach was associated with gains in engagement and critical thinking, unmeasured variables may also have contributed to these outcomes. Variations in teacher enthusiasm for innovation, prior professional development in inquiry methods, and school-level support for conceptt-based learning could have influenced results. Likewise, students' baseline academic ability and prior experience with collaborative work may have moderated their responsiveness to LbD activities. Future studies should measure and, where possible, statistically control for these factors to isolate the specific effects of the LbD intervention.

Effect Sizes and Practical Significance

While the ANOVAs and Tukey HSD tests revealed statistically significant differences in mean scores (e.g., Critical Thinking $M = 4.62$ vs. traditional $M = 3.85$), the study did not calculate standardized effect-size estimates. Reporting Cohen's d or η^2 values alongside p-values in future publications will clarify whether observed differences represent trivial, moderate, or substantial learning gains, thereby informing educators' decisions about the practical implementation of LbD strategies.

Appraisal of Methodological Rigor

The literature review encompassed both qualitative case studies (e.g., Fair, 2014; Cleggett, 2024) and mixed-methods experimental designs (e.g., Charles, 2020) that illuminate implementation processes and outcomes. In contrast, the present study focused largely on descriptive and inferential statistics, without integrating the richer qualitative analyses that explain how and why LbD practices succeed. Incorporating exemplar classroom vignettes or thematic interview findings in future work would enhance explanatory depth and align more closely with the methodological strengths of cited studies.

Conflicting Findings in the Literature

Although the majority of research highlights the benefits of concept-based and inquiry-driven approaches, some investigations report mixed or neutral effects. For example, Hennessy et al. (2021) identified institutional constraints and insufficient educator preparation as barriers to effective inquiry, while Ramnarain (2016) noted challenges among students with limited prior exposure to autonomous learning environments. A balanced analysis of such counter-examples will better delineate the conditions under which LbD may underperform and guide targeted improvements in teacher training and resource allocation.

Identified Research Gaps

Despite documented short-term gains, the durability of global-competence skills over extended periods remains underexplored. Moreover, few studies examine the economic and logistical feasibility of scaling LbD in resource-constrained contexts or across diverse cultural environments. We recommend longitudinal investigations to assess the persistence of LbD outcomes and implementation-feasibility research to inform sustainable adoption of the LbD framework in varied educational settings.

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