

The Correlation Between Core Competency–Oriented Curriculum Implementation and the Development of Students' Higher–Order Thinking: A Case Study of Inquiry–Based Teaching in High School Science

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Abstract

This study aimed to 1) explore the relationship between core competency–oriented curricula and the development of higher–order thinking skills in high school science education, 2) analyze the impact of inquiry–based teaching on students' analytical, evaluative, and creative thinking abilities, and 3) examine the challenges and opportunities associated with the implementation of core competency–oriented and inquiry–based teaching strategies in high school science classrooms. The sample consisted of 90 high school science students from three different schools in a city, randomly divided into experimental and control groups. The experimental group received core competency–oriented curriculum combined with inquiry–based teaching, while the control group followed traditional teaching methods. Data were collected through pre– and post–intervention surveys, focusing on students' higher–order thinking abilities, including analysis, evaluation, and creativity. Additionally, semi–structured interviews were conducted with 6 teachers involved in the teaching process together insights into their experiences and challenges. The research results were found as follows; 1) The experimental group showed significant improvements in their higher–order thinking skills compared to the control group, with gains in analysis, evaluation, and creativity ($p < 0.05$), 2) Teachers observed increased student engagement, critical thinking, and problem–solving abilities in the experimental group, and 3) The main challenges included time management and balancing inquiry activities with content coverage, but opportunities for improvement were found in teacher training and the use of educational

technology. The findings provide valuable insights into the effectiveness of integrating core competency-oriented curricula with inquiry-based teaching to enhance students' cognitive skills and suggest practical strategies for overcoming challenges in high school science education.

Keywords: Core Competency; Inquiry-Based Teaching; Higher-Order Thinking; High School Science; Curriculum Integration

Introduction

In recent years, educational reforms have increasingly emphasized the importance of cultivating students' core competencies, particularly critical thinking and creative thinking. With the rapid development of the knowledge society, simply mastering subject knowledge is no longer sufficient to meet the demands of the future workforce. Instead, the goal of education has shifted toward nurturing high-quality talents who possess independent thinking and innovative capabilities (de Jong et al., 2005; Dori et al., 2003). Core competencies encompass a wide range of essential skills, including problem-solving, collaboration, communication, and adaptability, all of which are crucial for students' future success (Fang et al., 2008). Among these, the development of higher-order thinking abilities, such as analysis, evaluation, and creativity, is especially critical. These abilities not only lay the foundation for deeper knowledge acquisition but also serve as key drivers for stimulating students' innovation and practical skills (Justice et al., 2009).

Bloom's Taxonomy provides a well-established framework for understanding higher-order thinking, categorizing these abilities as analysis, evaluation, and creation (Bloom, 1956). Cultivating these abilities requires the implementation of systematic and scientifically designed teaching strategies (Kabar, 2023).

In the context of high school science education, inquiry-based teaching (IBT) offers a modern pedagogical approach that fosters the development of higher-order thinking skills. IBT emphasizes student participation in discovering problems, formulating questions, and exploring solutions through experiments and discussions, moving away from the traditional teacher-centered model (Kang, 2022). This student-centered approach helps students not only grasp scientific concepts more effectively but also develop critical thinking, analytical reasoning, and creative problem-solving abilities—key components of higher-order thinking. These skills are essential for students' holistic development and will play a crucial role in their academic and professional futures (Li & Ma, 2023).

Despite the theoretical alignment between core competency-oriented curricula and the enhancement of higher-order thinking, effectively implementing these strategies in the classroom remains a challenge. Previous research has shown that inquiry-based teaching can significantly enhance students' core competencies, particularly in high school science education (Liu et al., 2024). However, many educators face challenges in balancing content delivery with the need to foster higher-order thinking, especially within the constraints of standardized curricula (Meulenbroeks et al., 2024). This gap in empirical research is critical, as there is a lack of well-documented and systematic strategies to support the development of higher-order thinking through inquiry-based teaching methods (Morris, 2025). Moreover, methodological gaps also persist in existing studies, especially regarding the lack of comprehensive evaluation methods to measure the impact of these teaching practices across diverse student populations.

Therefore, this research seeks to explore how core competency-oriented curricula can be more effectively integrated into teaching practices to foster higher-order thinking in high school science classrooms. It addresses the knowledge gap by proposing empirically supported strategies and provides a methodological framework for evaluating the impact of these approaches in real-world teaching settings (Ormanci & Cepni, 2025). By investigating effective teaching strategies and practices, this study not only aims to help students better master knowledge but also contributes to cultivating innovative talents capable of adapting to future societal challenges (Xu & Wu, 2026).

Research Objectives

This study aims to investigate the relationship between the implementation of core competency-oriented curricula and the development of higher-order thinking skills in high school science education. The specific objectives are as follows:

1. Examine the impact of core competency-oriented curriculum on the development of higher-order thinking skills, such as analysis, evaluation, and creativity, in high school science students.
2. Evaluate the role of inquiry-based teaching in enhancing critical and creative thinking through student-led learning activities, such as problem formulation, experimentation, and data analysis.

3. Identify key factors influencing the effective integration of core competency-oriented curricula and inquiry-based teaching in promoting higher-order thinking skills, focusing on teaching strategies, resources, and student backgrounds.

Based on these findings, this research will propose strategies for improving high school science education to better foster students' higher-order thinking skills.

Literature Review

Inquiry-Based Teaching and Core Competencies

The role of inquiry-based teaching (IBT) in fostering core competencies has been widely acknowledged in educational research. IBT encourages students to actively engage with learning materials, explore concepts, and apply knowledge to solve problems, directly contributing to the development of higher-order thinking skills such as analysis, evaluation, and creativity. According to de Jong et al. (2025), inquiry-based instruction emphasizes student-centered learning, where students generate hypotheses, experiment, analyze data, and draw conclusions. These activities help students form a deeper conceptual understanding and promote critical thinking, aligning with the core competencies outlined in contemporary educational frameworks.

Xiao (2025) emphasizes the importance of IBT in fostering core competencies, particularly in high school physics. Through "learning by doing," IBT not only deepens students' understanding of physical concepts but also enhances their problem-solving, analytical, and evaluative skills. This approach promotes deeper engagement with the subject matter and helps integrate essential competencies such as critical thinking and problem-solving, making the learning process more meaningful and impactful.

The Combination of Direct Instruction and Inquiry-Based Teaching

While IBT is effective in cultivating higher-order thinking, combining it with direct instruction can optimize learning outcomes. The integration of direct instruction with inquiry-based learning is gaining traction as it combines the strengths of both methods. De Jong et al. (2025) argue that integrating direct instruction with inquiry cycles allows teachers to offer timely support, reducing errors and reinforcing foundational skills like problem-solving. This hybrid model ensures that students not only engage deeply with content through inquiry but also receive the structured guidance necessary to master key skills.

Research by Ormanci and Cepni (2025) supports this approach, showing that guided inquiry, when combined with structured teaching, enhances students' systems thinking skills. Their study highlights that when IBT is scaffolded with direct instruction, students can make stronger connections between concepts, leading to improved problem-solving and critical thinking abilities. This model is particularly effective in high school science education, where both conceptual understanding and mastery of foundational skills are crucial.

Inquiry-Based Teaching Across Disciplines

Although much of the research on IBT focuses on science education, the principles of inquiry have been successfully applied in other subjects such as English and mathematics. Ren and Deng (2025) explore the feasibility of IBT in English reading at the junior high school level, demonstrating that it encourages active student participation in exploring texts and forming interpretations. This approach helps cultivate essential competencies such as critical thinking and reading comprehension, motivating students to engage more deeply with texts and improve their analytical and evaluative skills.

In mathematics, Zhao et al. (2025) emphasize the role of IBT in fostering problem-solving skills. Their study shows that integrating interdisciplinary approaches within mathematics lessons allows students to engage in meaningful exploration of mathematical concepts. By using inquiry-based strategies that encourage students to investigate and question mathematical problems, the learning experience becomes more interactive, enhancing students' analytical skills. Zhao's work further suggests that a cross-disciplinary approach in subjects like mathematics can significantly strengthen students' core competencies.

Challenges and Opportunities in Implementing Inquiry-Based Teaching

Despite the well-documented benefits, the implementation of IBT in high school classrooms faces several challenges. Wang (2025) discusses difficulties in applying IBT in subjects like moral and legal education, citing limited teaching resources, time constraints, and the need for tailored teaching strategies. These challenges extend across other subjects, where the adoption of IBT requires careful planning and adaptation to fit specific curricula and student needs.

Deng (2025) examines the impact of external factors, such as standardized testing and rigid curricula, on the adoption of IBT. Although teachers recognize the benefits of IBT, they often face pressure from traditional educational structures that prioritize content coverage and exam preparation. Deng suggests that educators should incorporate strategies that balance inquiry-

based methods with essential knowledge transmission, ensuring students receive both deep engagement through inquiry and the necessary content knowledge for academic success.

In conclusion, the literature highlights that IBT is an effective pedagogical approach for developing core competencies, particularly higher-order thinking skills. The integration of direct instruction with inquiry-based learning can further enhance student outcomes by providing the support needed to master foundational skills. However, challenges related to resources, time constraints, and traditional educational pressures must be addressed to fully realize the potential of IBT across disciplines. Future research should focus on finding more effective ways to integrate these teaching methods and overcoming the practical obstacles hindering their widespread implementation.

Conceptual Framework

The conceptual framework for this study is based on the interplay between core competencies, inquiry-based teaching (IBT), and the development of higher-order thinking skills in high school science education. This framework explores how the implementation of core competency-oriented curricula can enhance the development of higher-order thinking skills through the application of IBT. To construct this framework, relevant educational theories, teaching methodologies, and key constructs related to core competencies and higher-order thinking are integrated.

Core Competencies and Higher-Order Thinking

Core competencies are essential skills that enable individuals to function effectively in a rapidly changing world. These include problem-solving, critical thinking, creativity, communication, collaboration, and adaptability. In educational contexts, core competencies serve as the foundation for preparing students to navigate academic and real-life challenges. The development of higher-order thinking skills—such as analysis, evaluation, and creation—is an integral part of core competencies. These skills enable students to engage in deep cognitive processes, allowing them to analyze complex problems, evaluate multiple perspectives, and generate innovative solutions (Bloom, 1956).

Fostering core competencies, particularly higher-order thinking, is a central goal of contemporary curricula. Higher-order thinking skills are essential not only for academic success but also for students' ability to thrive in an increasingly dynamic and interconnected world.

Inquiry-Based Teaching and Its Role in Promoting Higher-Order Thinking

IBT is a student-centered pedagogical approach that emphasizes active learning, critical thinking, and problem-solving through investigation and exploration. In IBT, students take responsibility for their own learning by asking questions, forming hypotheses, conducting experiments, analyzing data, and drawing conclusions. This process helps develop the skills necessary for higher-order thinking (Bransford et al., 2000).

The connection between IBT and the development of higher-order thinking is well-documented. IBT promotes active engagement with content, encouraging students to not only acquire factual knowledge but also apply it in new contexts, thereby fostering deeper understanding and critical thinking. Moreover, IBT challenges students to make connections between concepts, evaluate evidence, and generate new ideas—core aspects of higher-order thinking. Combining inquiry cycles with scaffolding from direct instruction provides students with both the opportunity for deep inquiry and the necessary support to master essential skills (de Jong et al., 2025).

Integration of Core Competencies and Inquiry-Based Teaching

The integration of core competencies and IBT is central to this study's conceptual framework. It hypothesizes that IBT, when aligned with core competency goals, can significantly enhance the development of higher-order thinking skills in high school students. This integration is grounded in the belief that inquiry-based methods provide students with opportunities to develop critical skills such as problem-solving, creativity, and critical thinking.

The successful integration of IBT and core competencies requires thoughtful curriculum design and the implementation of specific teaching strategies. Teachers must carefully design inquiry-based activities that align with learning objectives, provide appropriate scaffolding, and encourage reflection on the learning process.

The Role of Scaffolding in Inquiry-Based Teaching

Scaffolding is a critical component of the framework. It refers to the support provided by teachers or the learning environment to help students achieve tasks they cannot complete independently. In IBT, scaffolding is essential for guiding students through the complex process of inquiry. This support can take many forms, such as clear instructions, guiding questions, feedback, and appropriate teaching tools.

Scaffolding helps students connect prior knowledge with new information, structure their thinking, and overcome challenges during the inquiry process. As de Jong et al. (2025) suggest, combining inquiry with scaffolding enables students to explore concepts deeply while receiving the necessary guidance to master foundational skills. Scaffolding, therefore, is a key mechanism for integrating core competencies into IBT, supporting the development of higher-order thinking skills.

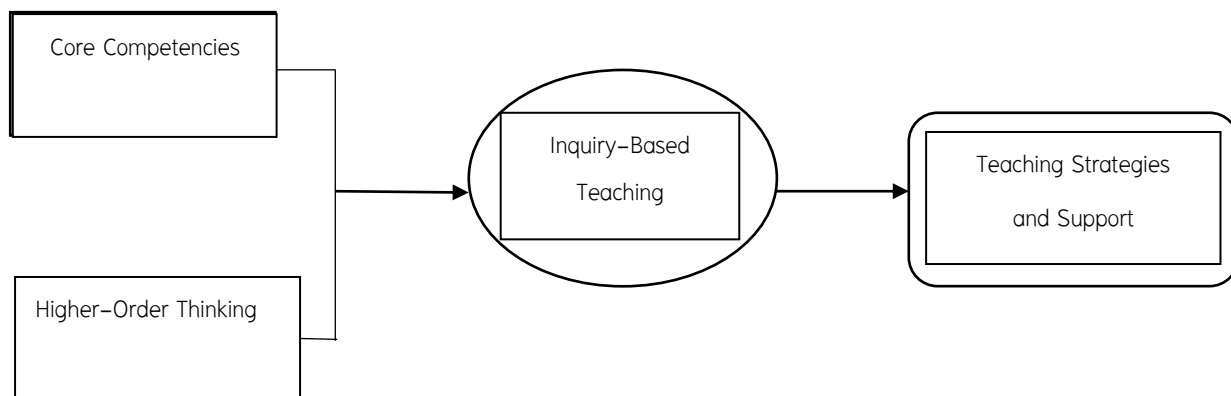


Figure 1 Conceptual Framework

Research Methodology

This study aims to empirically analyze the impact of core competency-oriented curriculum implementation and inquiry-based teaching on the development of higher-order thinking skills in high school science students. The research follows a mixed-methods approach, combining both quantitative and qualitative research methods to provide a comprehensive understanding of the effectiveness of these teaching strategies. The following is a detailed description of the research methodology, including the research design, subjects, data collection process, and analysis methods.

Research Design

This study employs a mixed-methods research design, which integrates both quantitative and qualitative approaches. The quantitative component includes survey questionnaires to assess changes in students' higher-order thinking skills, such as analysis, evaluation, and creativity, both before and after the intervention. The qualitative component consists of semi-structured interviews with teachers to explore their experiences and perceptions regarding the implementation of core competency-oriented curricula and inquiry-based teaching.

The combination of these methods ensures that the research objectives are comprehensively addressed, allowing for both statistical analysis and a deeper understanding of the contextual factors affecting teaching and learning.

Research Subjects

The research subjects will include high school science students and teachers from three schools in a specified city. The total sample size consists of 90 students and 6 teachers.

Students: The sample will consist of 30 students randomly selected from each of three schools, resulting in a total of 90 students. The selection criteria will be based on demographic diversity (e.g., gender, socioeconomic background) and academic performance to ensure a representative sample of students. The three schools will be selected based on similar academic profiles and willingness to participate in the study. The students from each school will be randomly assigned to either the experimental group (receiving the core competency-oriented curriculum and inquiry-based teaching) or the control group (receiving traditional teaching methods). The random assignment will be done using a computerized random number generator to ensure fairness and eliminate selection bias.

Teachers: The study will also include 6 high school science teachers who have experience in inquiry-based teaching. These teachers will be selected based on their willingness to participate and their experience with inquiry-based teaching methods. Teachers will be interviewed to understand their experiences with the teaching methods, their observations regarding the development of students' higher-order thinking skills, and the challenges they faced during implementation.

Data Collection

Survey Questionnaires: To measure students' higher-order thinking skills, survey questionnaires based on Bloom's Taxonomy will be used. The questionnaire will assess students' abilities in three key areas: Analysis, Evaluation, and Creation. The items will be designed to capture students' self-reported perceptions of their thinking abilities and problem-solving skills. The survey will be administered twice: once at the beginning (baseline data) and once at the end (post-test data) of the intervention. The Likert scale for each question will range from 1 (Strongly Disagree) to 5 (Strongly Agree).

Analysis: To what extent can students analyze problems from multiple perspectives?

Evaluation: To what extent are students able to evaluate the reliability and value of information?

Creation: To what extent can students creatively solve problems and propose new ideas?

Teacher Interviews: Semi-structured interviews will be conducted with the 6 participating teachers. The interviews will focus on the following key areas:

Experience with Inquiry-Based Teaching: Teachers will describe how they designed and implemented inquiry-based teaching and integrated core competency-oriented curricula into their lessons.

Student Feedback: Teachers will share their observations regarding changes in students' thinking abilities, particularly critical thinking, creativity, and problem-solving skills.

Teaching Challenges: Teachers will discuss the main challenges they faced while implementing these teaching strategies, such as time management, student engagement, and balancing content coverage.

Relationship Between Teaching Strategies and Student Performance: Teachers will provide insights into how different teaching strategies influenced students' higher-order thinking abilities.

Data Analysis

Quantitative Data Analysis: The data collected from the student surveys will be analyzed using SPSS statistical software. The following statistical methods will be applied:

Descriptive Statistics: To describe the distribution of students' higher-order thinking abilities before and after the intervention.

Paired Sample T-Test: To compare the pre-test and post-test scores of the experimental and control groups, determining if there is a statistically significant difference in the development of higher-order thinking skills.

Analysis of Variance (ANOVA): To examine the impact of different classes and teacher backgrounds on teaching outcomes and to compare the differences in thinking abilities between the experimental and control groups.

Qualitative Data Analysis: The qualitative data obtained from teacher interviews will be analyzed using thematic analysis. The following steps will be followed:

Data Coding: Interview transcripts will be coded to identify key themes and categories related to the development of higher-order thinking abilities.

Theme Categorization: Key themes such as teaching challenges, student engagement, and changes in students' thinking abilities will be identified and categorized.

Pattern Identification: The analysis will aim to identify common patterns across the teacher interviews regarding the effectiveness of inquiry-based teaching in enhancing students' higher-order thinking skills.

Ethical Considerations

All participants (both students and teachers) will be informed of the purpose and content of the study and will be required to sign informed consent forms. The confidentiality of all survey and interview data will be ensured. Participants' identities will be anonymized during the data analysis process to maintain confidentiality. All research procedures will comply with ethical guidelines for educational research to protect participants' rights and ensure the integrity of the study.

Research Limitations

Sample Limitations: The sample size of 90 students and 6 teachers may not fully represent the diverse population of high school science students across various regions. The findings may not be generalizable to all high school students, especially those in different educational systems or countries.

Scope of the Study: This study focuses solely on high school science education. The effectiveness of inquiry-based teaching may vary in other subjects (e.g., social studies, languages) or grade levels, which limits the generalizability of the findings to broader educational contexts.

Time Limitations: The study will be conducted over a relatively short period, which may limit the ability to observe long-term changes in students' thinking abilities. Future studies could extend the intervention period to examine the long-term effects of core competency-oriented curricula and inquiry-based teaching.

Curriculum and Teaching Methods: Detailed information on the core competency-oriented curriculum and inquiry-based teaching methods will be provided, including:

Teaching Steps: A description of the number of steps involved in the curriculum, lesson plans, and instructional strategies.

Learning Activities: Information on the types of activities (e.g., experiments, discussions, problem-solving tasks) used to engage students.

Learning Materials: The materials and resources used in the lessons, including textbooks, digital tools, and supplementary resources.

Assessment Methods: The tools and methods used to assess students' higher-order thinking skills at different stages of the curriculum.

This methodology provides a comprehensive approach to understanding the effects of core competency-oriented curricula and inquiry-based teaching on students' higher-order thinking skills. The use of both quantitative and qualitative methods allows for a robust analysis of the research questions, providing valuable insights into how these teaching strategies can foster critical thinking, creativity, and problem-solving abilities in high school science students.

Research Results

The study analyzed survey data from the experimental and control groups to assess the impact of core competency-oriented curriculum and inquiry-based teaching on students' higher-order thinking skills, including analysis, evaluation, and creativity. The results indicate that students in the experimental group showed significant improvements in these areas compared to the control group.

Table 1 Changes in Higher-Order Thinking Skills of Students in the Experimental and Control Groups (Pre-test and Post-test)

Dimension	Experimental	Experimental	Control	Control	Difference (Experimental Group)	Difference (Control Group)	P-value
	Group	Group	Group	Group			
	Pre-test Mean	Post-test Mean	Pre-test Mean	Post-test Mean			
Analytical Skills	3.45	4.12	3.43	3.6	0.67	0.17	0.001
Evaluation Skills	3.58	4.21	3.55	3.65	0.63	0.1	0.002
Creative Skills	3.32	4.05	3.3	3.45	0.73	0.15	0.003

1. Results Analysis:

Analytical Skills: The experimental group showed a larger improvement (+0.67) compared to the control group (+0.17), with a significant difference ($P = 0.001$).

Evaluation Skills: The experimental group had a +0.63 improvement, while the control group showed an increase of only +0.10, with a significant difference ($P = 0.002$).

Creative Skills: The experimental group's creative skills improved by +0.73, compared to +0.15 in the control group, with a significant difference ($P = 0.003$).

These findings address Objective 2 : Analyze the impact of inquiry-based teaching on students' analytical, evaluative, and creative thinking abilities. The data clearly demonstrate the significant impact of the experimental teaching methods on students' higher-order thinking skills.

2. Teacher Interview Results

The teacher interviews provided valuable insights into the implementation of inquiry-based teaching and its effects on students' higher-order thinking abilities. The results highlighted several key themes, with a focus on how inquiry-based teaching enhances critical thinking and creativity, and the challenges faced by teachers in adopting these methods.

Teacher Recognition of Inquiry-Based Teaching: All interviewed teachers acknowledged that inquiry-based teaching helped enhance students' critical thinking and creativity. Teachers observed significant improvements in students' analytical and creative thinking, particularly through hands-on activities like experimentation and data analysis.

Teaching Challenges: One of the main challenges identified by teachers was time management, particularly in balancing inquiry-based activities with the need to cover the required course content. Teachers noted that while inquiry-based teaching fostered active learning, it also required more time and effort to design and implement effectively.

Student Engagement: Teachers observed that students in the experimental group were more engaged and proactive in their learning. These students frequently asked questions, participated in discussions, and demonstrated greater enthusiasm for the subject matter. In contrast, students in the control group were more passive and less engaged in class.

Key Result: The teacher interviews primarily address Objective 3: Examine the challenges and opportunities associated with the implementation of core competency-oriented and inquiry-based teaching strategies in high school science classrooms. The results highlight the benefits of inquiry-based teaching in fostering student engagement and critical thinking, as well as the challenges related to time management and content coverage.

3. The Relationship Between Teaching Strategies and Student Performance

The teacher interviews also revealed the impact of specific teaching strategies on students' higher-order thinking abilities. The following strategies were particularly effective:

Problem-Driven Learning: Teachers employed challenging questions to stimulate students' interest and encouraged them to think critically about the material. This approach significantly enhanced students' analytical and evaluative skills.

Collaborative Learning: Group work was another strategy that helped students deepen their understanding of the material. Collaboration allowed students to share different perspectives, which strengthened their analytical and creative thinking.

These findings support Objective 3 by showing that specific teaching strategies, such as problem-driven learning and collaborative activities, can significantly enhance students' higher-order thinking skills.

4. Summary of Research Findings

Based on the quantitative analysis of survey data and qualitative insights from teacher interviews, the study found that core competency-oriented curricula and inquiry-based teaching significantly enhance the development of students' higher-order thinking skills. Students in the experimental group showed notable improvements in analytical, evaluative, and creative thinking.

Teacher interviews highlighted that inquiry-based teaching provided opportunities for active learning, which promoted the development of higher-order thinking skills. However, challenges such as time management and balancing content coverage with inquiry activities were identified as barriers to fully implementing these teaching strategies.

In conclusion, the research confirms that integrating core competency-oriented curricula with inquiry-based teaching leads to significant improvements in students' higher-order thinking skills. The study also highlights the importance of addressing practical challenges, such as time constraints, to ensure the successful implementation of these strategies.

Discussions

This study investigates the impact of core competency-oriented curriculum implementation and inquiry-based teaching on the development of higher-order thinking skills in high school science students. The key findings from the study show that both core competency-oriented curricula and inquiry-based teaching significantly enhance students' critical thinking, creativity, and problem-solving abilities. The following discussion addresses these findings in relation to the research objectives and relevant educational theories.

The Role of Core Competency-Oriented Curriculum in Enhancing Higher-Order Thinking

The results demonstrate that core competency-oriented curricula play a significant role in improving students' higher-order thinking skills, particularly in analysis, evaluation, and creativity. Students in the experimental group exhibited larger improvements compared to the control group. This aligns with Zhao et al. (2025), who argue that curricula focusing on core competencies foster deeper cognitive engagement and improve problem-solving abilities. Core competency-oriented

curricula emphasize critical thinking, creativity, and problem-solving, encouraging students to move beyond rote memorization and engage in more complex cognitive tasks.

The shift from traditional, content-driven teaching to one that emphasizes the development of cognitive skills reflects contemporary learning theories. Theories such as constructivism (Vygotsky, 1978) emphasize the importance of active learning environments where students construct their own understanding. The integration of inquiry-based teaching into core competency-oriented curricula allows students to take an active role in their learning, which, as research by de Jong et al. (2025) suggests, is crucial for promoting higher-order thinking. This combination of strategies ensures that students not only improve their knowledge retention but also gain the cognitive skills necessary for real-world applications.

The Impact of Inquiry-Based Teaching on Higher-Order Thinking

One of the primary findings of this study is the positive impact of inquiry-based teaching on students' higher-order thinking. Students who engaged in inquiry-based learning showed substantial improvements in analytical, evaluative, and creative thinking. This supports the work of Bransford et al. (2000), who found that inquiry-based teaching promotes deep, reflective thinking and enhances students' abilities to analyze, evaluate, and create. Inquiry-based teaching allows students to explore, question, and experiment with scientific concepts actively, leading to a deeper conceptual understanding and the development of problem-solving skills.

Incorporating scaffolding (Wood et al., 1976) into the inquiry-based approach provides students with the necessary support to master both foundational knowledge and higher-order thinking skills. This is particularly evident in the integration of direct instruction with inquiry cycles, as noted by de Jong et al. (2025). While inquiry-based methods encourage independent exploration, scaffolding ensures that students are guided appropriately, reinforcing learning and cognitive development.

However, the success of inquiry-based teaching depends heavily on the teacher's ability to design effective inquiry activities and manage classroom dynamics. Teachers must balance providing guidance while allowing students the freedom to explore, a challenge noted by Wang (2025), who observed that time constraints and curriculum demands often interfere with the successful implementation of inquiry-based methods.

Teaching Challenges and Opportunities

The study also highlights several challenges and opportunities in implementing core competency-oriented and inquiry-based teaching. Time management was a recurring issue, with

teachers reporting difficulties in balancing the demands of covering content with the time required for inquiry-based activities. This concern aligns with Deng (2025), who discussed how traditional curricula, with their focus on content coverage and standardized testing, can hinder the adoption of inquiry-based methods. However, the study also identified teacher professional development as a key factor in overcoming these challenges. Teachers who received training in inquiry-based teaching methods were more confident and effective in their implementation.

Another opportunity highlighted in the study is the integration of educational technology. The growing availability of digital tools, such as virtual labs and collaborative online platforms, can enhance the interactivity and engagement of inquiry-based lessons. This aligns with research by Ormanci and Cepni (2025), who suggest that web-assisted inquiry approaches improve students' systems thinking skills and overall learning outcomes. As such, integrating technology into inquiry-based teaching could help bridge gaps in resource-constrained environments, further enhancing the learning experience.

Implications for Practice

The findings from this study suggest several implications for educational practice. First, schools and educators should prioritize integrating core competency-oriented curricula with inquiry-based teaching strategies. These methods have been shown to effectively foster higher-order thinking skills, which are essential for students' academic success and future career readiness. The results emphasize the need for teacher professional development programs focused on inquiry-based teaching and the integration of core competencies. Teachers should be provided with the knowledge and skills to design and implement inquiry-based lessons effectively.

Additionally, schools should explore the use of educational technology to support inquiry-based learning. Digital tools can enhance student engagement and provide a more interactive, personalized learning experience. By leveraging technology, teachers can create dynamic and inclusive learning environments that cater to diverse student needs and promote higher-order thinking.

Future Research Directions

While this study provides valuable insights, future research could expand on these findings in several ways. First, it would be beneficial to increase the sample size to include a broader range of schools and students, allowing for more generalizable conclusions. Second, future studies could examine the long-term effects of core competency-oriented and inquiry-based teaching on students' academic and professional outcomes. Finally, exploring the application of these teaching

methods in other subjects, such as mathematics or the humanities, would provide valuable insights into the broader applicability of these approaches across disciplines.

This study provides strong evidence that core competency-oriented curricula and inquiry-based teaching significantly enhance high school students' higher-order thinking skills. By fostering critical thinking, creativity, and problem-solving abilities, these teaching methods prepare students for future academic and professional challenges. Despite the challenges associated with implementation, such as time management and content coverage, the opportunities presented by teacher professional development and the integration of educational technology offer promising solutions to enhance the effectiveness of inquiry-based teaching in high school science education.

New Knowledge from Research

This study provides new insights into how core competency-oriented curricula and inquiry-based teaching contribute to the development of higher-order thinking skills in high school science students. The research confirms that inquiry-based teaching, which encourages active student engagement in problem-solving, experimentation, and collaboration, significantly enhances their analytical, evaluative, and creative thinking abilities. Students in the experimental group showed notable improvements in these skills compared to those in the control group, indicating the effectiveness of this integrated teaching approach. This finding surpasses previous studies by clearly demonstrating that the combination of core competency-oriented curricula and inquiry-based teaching can foster deeper cognitive engagement and promote critical thinking. Despite challenges such as time constraints, teacher professional development and the integration of educational technology are key factors in overcoming these barriers. Teachers who received training in inquiry-based methods were more capable of effectively implementing these strategies, thus enhancing student learning. Additionally, the use of educational technology provides greater flexibility and interactivity, further supporting inquiry-based learning. Overall, the study suggests that integrating core competency-oriented curricula with inquiry-based teaching significantly enhances students' higher-order thinking skills, preparing them for future academic and professional success.

Conclusion

This study highlights the significant role of core competency-oriented curricula and inquiry-based teaching in enhancing higher-order thinking skills in high school science students. The findings show that when combined, these teaching methods lead to notable improvements in students' analytical, evaluative, and creative abilities. By promoting active learning and critical thinking, inquiry-based teaching encourages students to engage deeply with content and develop essential cognitive skills. Although challenges such as time constraints and curriculum coverage remain, the study suggests that teacher training and the use of educational technology can help overcome these barriers. Ultimately, the integration of core competency-oriented curricula and inquiry-based teaching provides an effective approach to fostering students' higher-order thinking skills, better preparing them for academic success and future professional challenges. Future research should further explore the long-term effects of these methods and their application in various subjects.

Suggestions

Based on the findings of this study, the following recommendations are made for improving high school science education:

Enhance Teacher Training: Teachers should receive continuous professional development focused on inquiry-based teaching methods and core competency-oriented curricula. This will enable educators to better support the development of students' higher-order thinking skills and enhance the effectiveness of their teaching practices.

Integrate Educational Technology: Schools should utilize educational technology to support inquiry-based learning, making lessons more interactive and accessible. This is particularly important in resource-constrained environments, where digital tools can help overcome physical limitations and engage students more effectively in the learning process.

Balance Content and Inquiry: While inquiry-based teaching is effective, it is essential to strike a balance between content coverage and inquiry activities. Schools should design flexible curricula that allow for both comprehensive content delivery and inquiry-based learning, ensuring that students gain both knowledge and critical thinking skills.

Promote Active Learning: Schools should adopt more student-centered approaches, emphasizing active learning, critical thinking, and problem-solving, rather than traditional lecture-based methods. These approaches encourage students to take ownership of their learning and develop skills that are essential for future academic and professional success.

Further Research: Future research should explore the long-term impact of inquiry-based teaching across various subjects and contexts, providing a broader understanding of its effectiveness. Comparative studies between student groups from different academic programs, geographical contexts, or school environments (such as school size or location) would help assess how these teaching methods perform across diverse settings. Research should also specify how it will be conducted, including the selection of participant groups, the methods for data collection, and the involvement of educators and administrators.

These suggestions aim to help educators implement more effective teaching practices that foster the development of essential cognitive skills in students and improve educational outcomes.

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