Developing High Order Competencies in Students Through the Integration of Research-Oriented Activities

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Abstract

Developing higher-order skills (HOS), such as critical thinking, creativity, and problem-solving, is essential for students to thrive in today's dynamic and competitive environment. This study examines the effectiveness of project-based learning (PBL), inquiry-based learning (IBL), and mentoring in developing HOS among students and identifying the best ROA for achieving such development. A quantitative research design was used, and self-developed questionnaires were employed for the data collection. Purposive random sampling was used to get data from 317 high school respondents. The instrument's reliability was measured using a Cronbach's alpha of 0.93, indicating a high internal consistency. The findings revealed that PBL and IBL are highly effective in promoting critical and creative thinking, while mentoring has limited direct support for HOS. The structural equation modelling (SEM) results showed that research activities are the best predictors of HOS ($\beta = .79$, $p < .01$), explaining 62% of the variance. At the same time, mentoring has a weak but significant relationship with research activities and no direct impact on HOS. Promoting PBL, IBL, and mentoring in educational practices is highly emphasized. The integration of mentoring with structured ROA is recommended for its improvement in effectiveness, followed by investment in teacher training programs and addressing geographic disparities in educational resource allocation. In adopting these measures, they prepare the complete learning atmosphere with skills that students require to deal with real-world challenges and to excel in interdisciplinary environments.

Keywords: Higher-order Skills, Project-Based Learning, Inquiry-Based Learning.

Introduction

In an increasingly complex and competitive world, the ability to think critically, solve problems creatively, and make informed decisions is paramount. These higher-order skills (HOS)—including analyzing, evaluating, and creating—are vital for navigating uncertainty and innovating solutions in a knowledge-driven economy (Jaenudin et al., 2020). Traditional teaching methods often emphasize rote memorization, leaving a gap in fostering higher-order thinking. This has led educators to explore pedagogical models like Project-Based Learning (PBL), Inquiry-Based Learning (IBL), and mentoring. A recent meta-analysis found that PBL has a moderate positive effect on HOS development, with a standardized mean difference of 0.387 ($p < 0.001$) (Zhang & Ma, 2023). Similarly, students in IBL classrooms score significantly higher in critical thinking assessments compared to traditional settings (Salame & Thompson, 2020).

Project-based learning (PBL) focuses on active, student-centred learning through real-world projects. It encourages collaboration, creativity, and problem-solving skills (Almulla, 2020). In

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the same way, inquiry-based learning (IBL) encourages students to investigate questions and find solutions, which helps them improve their critical and analytical thinking skills (Wale & Bishaw, 2020). Mentoring enhances these methods by offering individualized guidance, feedback, and support, which helps students grow academically and professionally (Mullen & Klimaitis, 2021). The shift toward active learning is also supported by evidence that students exposed to research-based activities perform up to 29% better in analytical tasks than those in lecture-based environments (Association of American Colleges & Universities, 2022). Students face challenges in developing higher-order thinking skills. Traditional teaching methods limit their analytical skill development. ROA i.e PBL and IBL offer the potential to address this limitation. These approaches can collectively develop students' high-order competencies.

Despite growing awareness, only 38% of university programs globally include dedicated modules to systematically develop students' higher-order thinking competencies (Beneitone, 2022). The gender gap in learning HOS remains underexplored. Gender and socioeconomic factors further influence the development of HOS. Research shows that female students often outperform males in critical thinking and written argumentation (Zhao, 2024). In contrast, a study of mathematics HOS revealed that while gender differences were minimal overall, girls outperformed boys in algebraic reasoning (Sridana et al., 2024). Moreover, a cross-national analysis showed that students from low socioeconomic backgrounds score up to 60 points lower in higher-order tasks compared to affluent peers (Mitani, 2021).

Addressing these gaps can enhance educational outcomes for diverse learners. ROA can bridge the gap between theory and practice. Therefore, the current study aims to evaluate the role of ROA in developing HOS among students, investigate gender-based differences, and identify the most effective approaches. Findings will help guide educational policy and curriculum design for equipping future-ready learners.

Research Objectives

1. To explore the impact of PBL on the development of students' HOS.
2. To examine how IBL contributes to enhancing students' HOS.
3. To assess the role of Mentoring in fostering HOS among students.
4. To identify the best research activities that effectively integrate HOS into the learning process.
5. To assess the gender gap in learning HOS through ROA.

Literature Review

High Order Skills (HOS)

According to Newman (1993), higher-order thinking skills (HOS) involve interpreting, analyzing, and manipulating information. HOS includes critical, creative, logical, and reasoning skills (Miedijensky et al., 2021; Kwangmuang et al., 2021) and aligns with Bloom's upper taxonomy levels: analyzing, evaluating, and creating (Jaenudin et al., 2020). Analyzing breaks down information (Lu et al., 2021), evaluating applies judgment (Villarroel et al., 2020), and creating generates new ideas (Sumarni & Kadarwati, 2020). Retnawati et al. (2020) added problem-solving and decision-making to HOS components. Critical thinking involves logical decision-making and reflective analysis (Cottrell, 2017; Akpur, 2020; Heard et al., 2020; DeMara et al., 2019). Akpur (2020) found HOS-based science questions significantly improved students' critical thinking. Indah (2020) developed a HOS-based lesson plan, achieving 99.66% validity, 85.93% practicality, and 33% pretest-posttest improvement. Creative thinking merges divergent and rational reasoning (Gerver et al., 2023; Siagian et al., 2023). The five identified traits of creative thinking mentioned in Table 1 are as follows.

Table 1: Five Traits of Creative Thinking among students

Creative Thinking Trait	Explanation
1	Creativity is closely linked to determination and effort.
2	It leads to the generation of something new or original.
3	Internal evaluation is more crucial for creativity than external judgment.
4	Creativity involves generating ideas without restrictive boundaries.
5	It often becomes evident during the process of achieving tasks.

Ritter et al. (2020) found a year-long creativity program improved ideation and flexibility but not originality. Simanjuntak et al. (2021) reported improved creative and problem-solving skills using PBL and simulation. Table 2 outline traits and signs of creativity.

Table 2: Signs of Creativity among students

Signs of Creativity	Explanation
Fluency	The ability to generate numerous ideas.
Flexibility	The ability to think of diverse ideas or approaches.
Originality	The skill to create unique and innovative concepts.
Elaboration	The ability to build on ideas to create more detailed and complex concepts.

Problem-solving varies by complexity (Dood & Watts, 2022). Mahanal et al. (2022) used the RICOSRE model to improve problem-solving across ability levels. Ichsan et al. (2023) found worksheets improved concept mastery but not problem-solving. Table 3 summarizes skills or strategies for developing creativity among pupils.

Table 3: Skills/Strategies to develop Creativity

Skill/Strategy	Description
Thinking Outside the Box	Approaching challenges with innovative and creative solutions
Anticipating Potential Issues	Identifying and preparing for challenges before they arise
Collaborative Problem-solving	Solving problems effectively through teamwork and cooperation
Understanding the Problem	Analyzing and breaking down issues into manageable components
Brainstorming Effectively	Generating diverse solutions using structured techniques
Researching Thoroughly	Gathering comprehensive data from reliable sources
Thinking Critically	Objectively analyzing and evaluating different perspectives
Working Collaboratively	Promoting teamwork with aligned goals and open communication
Benefits for Employers	Improved efficiency, cost reduction, and fostering innovation
Benefits for Employees	Enhanced skills, career growth, and better employability

Decision-making involves choosing the best option (Nehass et al., 2024). Deniz (2004) linked decision-making styles to problem-solving in students. Sumarni & Kadarwati (2020) provided HOS evaluation criteria. They also highlighted the criteria for students' critical and creative thinking skills below in Table 4.

Table 4: The Criteria for Students' Critical and Creative Thinking Skills (Sumarni & Kadarwati, 2020)

Percentage (%)	Level
$70 < \% \leq 100$	High
$29 < \% \leq 70$	Medium
$\% \leq 29$	Low

Abosalem (2016) and Saido et al. (2018) found limited HOS emphasis in assessments. Kwangmuang et al. (2021) reported improved HOS through learning innovations. Despite numerous studies, few integrate research-based strategies like PBL and IBL to holistically foster HOS. Many studies have examined HOS development, but few have examined how to integrate ROA to foster these competencies. Research has focused on HOS's components, such as critical and creative thinking, problem-solving, and decision-making, using discovery learning, problem-based learning, or creative problem-solving worksheets. These studies rarely discuss how integrating ROA can improve all higher-order competencies. Much of the current literature focuses on secondary education or individual academic subjects, not cross-disciplinary approaches or diverse educational settings. There are also few longitudinal studies on how ROA affect students' cognitive and practical skills. Addressing these gaps can help develop comprehensive strategies for fostering student higher-order competencies. This study addresses these gaps to understand better how integrated research-oriented frameworks like PBL and IBL can maximize HOS in students.

Research Activities

Project-Based Learning

Project-Based Learning (PBL) is a student-centred instructional method promoting active learning through real-world problem-solving (Almulla, 2020). It supports collaboration, creativity, and critical thinking in authentic contexts (Sumarni & Kadarwati, 2020) and integrates interdisciplinary knowledge, often within STEM/STEAM frameworks (Wahono et al., 2020; Hawari & Noor, 2020). PBL emphasizes autonomy, inquiry, and meaningful products, guided by teacher facilitation (MacLeod & Van der Veen, 2020; Duke et al., 2021). Lin et al. (2021) noted enhanced cognitive skills in preservice teachers through engineering design processes within STEM-PBL. Samsudin et al. (2020) found that PBL strengthens self-efficacy and applies theory in collaborative settings.

Blended learning complements PBL by supporting flexible, online interaction (Yustina et al., 2020). Sumarni and Kadarwati (2020) reported medium-level gains in critical (44.4%) and creative (47.4%) thinking among 230 high school students via ethno-STEM PBL. In pandemic contexts, Yuliansyah and Ayu (2021) found PBL improved students' media research, collaboration, and communication skills through virtual public presentations. Yustina et al. (2020) showed higher creative thinking in a PBL-blended learning group (score 91, N-gain 0.62) than in a conventional group (score 76, N-gain 0.51).

Duke et al. (2021) conducted a cluster RCT in low-SES schools, finding PBL significantly improved second-grade students' social studies, reading, writing, and motivation. Despite these benefits, current research rarely explores how ROA can be systematically embedded within PBL to develop higher-order competencies like creativity, problem-solving, and critical thinking. Studies like Lin et al. (2021) and Duke et al. (2021) show targeted improvements, but a comprehensive, research-integrated PBL model is lacking. This gap calls for new frameworks that systematically incorporate research into PBL, promoting interdisciplinary learning and enhancing HOS across educational levels and diverse contexts.

Inquiry Based Learning

Inquiry-Based Learning (IBL) promotes student-driven exploration of questions and scenarios, enhancing understanding and higher-order thinking skills (Wale & Bishaw, 2020; Prananda et al., 2020). It encourages critical thinking, creativity, and independent learning (Tyas & Naibaho, 2021). IBL complements project-based learning through student-led inquiry and problem-solving (Lee & Galindo, 2021). The integration of mobile technologies further enhances IBL by enabling real-time access to diverse resources (Pedaste et al., 2020; Becker et al., 2020). Kaçar et al. (2021) found that IBL improves academic performance through real-world challenges, while Öztürk et al. (2022) confirmed its effectiveness across educational contexts. IBL is adaptable to various education levels. Santana-Vega et al. (2023) demonstrated its success in universities, while Paseka et al. (2023) explored its relevance in teacher training. Scaffolded IBL environments, as supported by Al Mamun et al. (2020), foster self-directed and inclusive learning. Key characteristics of IBL include investigation, collaboration, problem-solving, and analytical thinking. Wale and Bishaw (2020) showed that inquiry-based writing instruction significantly enhanced critical thinking skills such as interpretation, evaluation, and self-regulation.

Tyas and Naibaho (2021) affirmed the role of HOS-based learning in developing creativity, decision-making, and problem-solving. Pedaste et al. (2020) reviewed augmented reality's effectiveness in supporting IBL's Conceptualization phase but noted limited exploration in other learning phases. Despite IBL's documented benefits, there remains a significant gap in research examining the integration of structured, ROA into IBL to develop higher-order competencies. Existing studies focus on outcomes of inquiry and technology use but overlook how research strategies can support authentic inquiry and interdisciplinary skills. Further investigation is needed into designing and implementing research-driven IBL frameworks to effectively cultivate HOS across contexts and educational levels.

Mentoring

Mentoring is a process that helps people develop by having experienced individuals guide others, which promotes personal and professional growth (Mullen & Klimaitis, 2021). It is a structured partnership that focuses on developing skills and provides support, feedback, and opportunities for development (Chong et al., 2020; Afandi, 2021). Mentoring improves confidence, decision-making, and career development while establishing relationships built on trust, mutual respect, and collaboration (Pollard & Kumar, 2021; Hairon et al., 2020). Some main characteristics are adaptability, personalized support, continuous feedback, and goal orientation (Ng et al., 2020; Hairon et al., 2020). Effective mentors provide guidance, emotional support, and constructive feedback, empowering mentees to achieve professional and personal growth (Gruber et al., 2020; Afandi, 2021). Technology-based mentoring increases access through virtual platforms by overcoming geographical barriers (Krishna et al., 2020). Mentoring can be used in many fields, including education, healthcare, and research. It promotes sustainable development and encourages reflective practice (Ng et al., 2020; Krishna et al., 2020).

Stoeger et al. (2021) identified seven critical elements for effective mentoring: integrating research, contextual alignment, goal orchestration, and continuous evaluation. Afandi (2021) found that mentoring accelerates skill development, enhances career opportunities, and fosters leadership regeneration, enabling organizations like Hutama Karya to sustain competitiveness. Hairon et al. (2020) demonstrated the positive impact of a structured mentoring program for teachers, emphasizing the importance of relevance, applicability, and structured delivery for effective mentoring. While extensive research has highlighted the benefits of mentoring in promoting personal and professional growth, skill development, and career advancement, a notable gap exists in its application for developing higher-order competencies through ROA.

Current studies, such as those by Stoeger et al. (2021) and Afandi (2021), emphasize mentoring's role in fostering decision-making, leadership, and reflective practice.
However, they do not explore how structured mentoring frameworks can systematically integrate ROA to cultivate critical thinking, problem-solving, and creativity among students. Similarly, while Hairon et al. (2020) underscore the importance of structured mentoring programs, their findings are limited to specific professional contexts and lack focus on interdisciplinary research skills. As discussed by Krishna et al. (2020), technology's role in mentoring remains underexplored in guiding students in research-intensive environments. These gaps necessitate further investigation into mentoring strategies tailored to integrating research activities for fostering higher-order competencies in diverse educational settings.

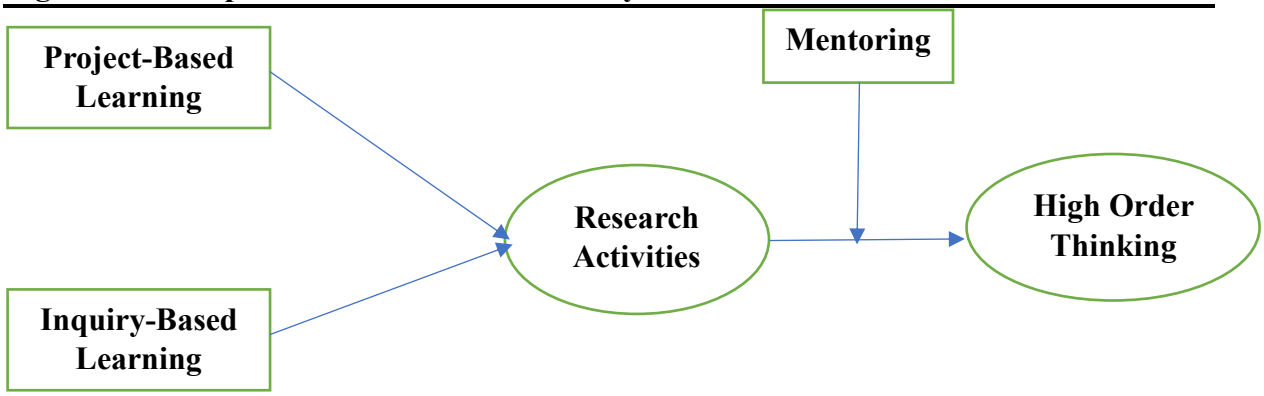
Methodology

The present study employed a quantitative research design to investigate the effect of Project-Based Learning (PBL) and Inquiry-Based Learning (IBL) with Mentoring as mediation on student high-order skills at a specific moment due to research activities. The students of higher education with diverse cognitive abilities and educational backgrounds were chosen. The persuasive sampling method was used for data collection from 317 respondents by sampling students from different disciplines. Purposive sampling refers to non-probability sampling types to obtain units with required characteristics. Contrarily, purposive sampling takes care of such units as those "on purpose." Students' analytical abilities have been determined using a self-assessment questionnaire (HOSQFS). It allows students to identify their competence regarding analyzing data with solutions provided and decision-making. HOSQFS displays high-order skills developed through PBL, IBL, and Mentoring. The analysis of students' involvement in PBL and IBL regarding their high-order skills was done through descriptive and inferential statistics such as mean and standard deviation and correlation analysis, respectively, using IBM SPSS 24. Structural Equational modelling and model fitness are conducted using WarpPLS 8.0 software.

Conceptual Framework

The current study's framework emphasizes research activities as development modes for students' HOS. It consists of two learning types, Project-Based Learning (PBL) and Inquiry-Based Learning (IBL), with moderating effects of Mentorship. These methods connect with the idea of Research Activities, which serve as a precursor to enhancing students' high-order skills (HOS). The study sets the foundation for the idea that mentoring plays a moderating role in enhancing high-order skills among students. Mentoring plays a crucial role in guiding students through this process. By offering personalized support and expertise, mentors enhance the learning experience, helping students refine their research methods, overcome obstacles, and achieve clarity in their thought processes. The two learning activities work together to create a holistic way of improving high-order thinking. The importance of stimulating inquiry-based learning for skills in students to analyze and critically evaluate information through establishing a connection to research activity is illustrated in this study. This study thus investigates how best to carry out those research activities -to improve students' high-order thinking skills, with mentoring as a moderating variable in preparation for challenges in real life.

Figure 1: Conceptual Framework of the Study



Results

Demographics

Table 5 presents the demographic breakdown of the respondents. In terms of area, the respondents are almost evenly split between urban (133, 42%) and rural (144, 45%) areas, ensuring balanced representation from both settings. Regarding gender, the majority of respondents are male (199, 63%), while female respondents account for 118 (37%), indicating a higher male representation in the sample. The discipline distribution is nearly equal, with science students comprising 159 (50%) of the sample and arts students accounting for 158 (50%), reflecting a balanced representation across academic fields. This demographic distribution ensures diverse perspectives in the study, with relatively even representation across disciplines.

Table 5: Interpretation of Demographics of Respondents

Area	Respondents
Urban	133
Rural	144
Gender	
Male	199
Female	118
Discipline	
Science	159
Arts	158
Total	***317***

Descriptive Statistics

Table 6 below highlights that PBL has the highest mean (M = 3.92, SD = 0.82), reflecting its strong role in promoting critical thinking and practical problem-solving. IBL follows closely (M = 3.89, SD = 0.861), emphasizing its importance in fostering curiosity and analytical skills, though with slightly more variability in perceptions. Mentoring scores marginally lower (M = 3.87, SD = 0.83), suggesting it plays a supportive but less impactful role compared to the learning strategies. HOS, as the outcome variable, has the lowest mean (M = 3.85, SD = 0.81), indicating room for improvement in achieving advanced cognitive competencies.

Table 6: Interpretation of Descriptive Statistics

Research Activities	Mean	Std. Deviation
Project-Based Learning	3.92	0.82
Inquiry-Based Learning	3.89	0.861
Mentoring	3.87	0.83
High order skills	3.85	0.81

Inferential Statistics

The correlation analysis in Table 7 demonstrates a strong positive relationship with a Pearson correlation coefficient of r = 0.705, which is statistically significant at the 0.01 level (p = 0.000, 2-tailed). This indicates a high degree of association between PBL and IBL, suggesting that improvements or higher implementation in one learning approach are strongly linked to improvements in the other. The consistent sample size (N = 317) for both variables strengthens the reliability of these findings. The statistical significance and high correlation reflect the complementary and interrelated nature of PBL and IBL in promoting critical thinking and active learning. These results underscore the importance of integrating both strategies in educational settings, as their combined use may enhance overall student engagement and cognitive skill development. The significant correlation further validates their shared role in fostering effective and innovative learning environments.

Table 7: Interpretation of Correlation among PBL, LBL, SBL and *AS*

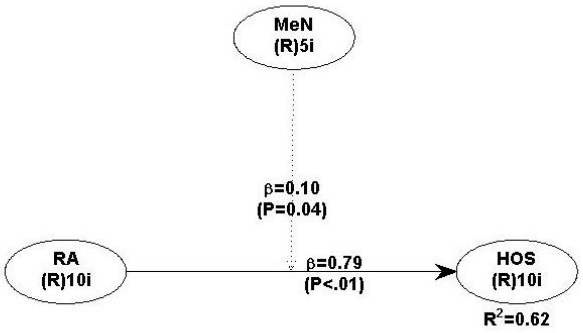
Variabes	Pearson Correlation	PBLM	IBLM
PBL	Pearson Correlation	1	.705**
	Sig. (2-tailed)		.000
	N	317	317
IBL	Pearson Correlation	.705**	1
	Sig. (2-tailed)	.000	
	N	317	317

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

Structural Equation Modeling

The provided Structural Equation Modeling (SEM) diagram in figure 2 illustrates the relationships among research activities (RA), mentoring (MeN), and higher-order skills/thinking (HOS). Research activities (RA) emerge as a strong predictor of higher-order skills, with a significant and positive path coefficient ($\beta = 0.79$, $p < .01$). This indicates that incorporating research-based activities has a substantial impact on enhancing students' ability to analyze, evaluate, and create. Additionally, there is a weak but significant positive relationship between research activities and mentoring ($\beta = 0.10$, $p = .04$), indicating that incorporating research-based learning can modestly enhance opportunities for mentoring. However, the diagram does not show a direct path between mentoring and higher-order skills, suggesting that mentoring alone may not independently contribute to cognitive skill development or that its effects are indirect or minimal within this model. The explained variance ($R^2 = 0.62$) indicates that 62% of the variance in higher-order skills is accounted for by the predictors, leaving 38% unexplained. This suggests that additional factors, such as collaborative learning, inquiry-based learning, or instructional strategies, may also significantly influence higher-order thinking. The absence of a stronger role for mentoring in this model highlights the need to reassess mentoring practices to ensure they effectively support the development of critical and creative thinking.

Figure 2: Structural Equational Modeling



Discussion

The findings of this study offer critical insights into the impact of Project-Based Learning (PBL), Inquiry-Based Learning (IBL), and mentoring on fostering higher-order skills (HOS) among students. PBL showed the highest effectiveness (M = 3.92, SD = 0.82), supporting Almulla (2020), Lin et al. (2021), and Sumarni and Kadarwati (2020), who highlighted its role in promoting critical and creative thinking. IBL also performed strongly (M = 3.89, SD = 0.861), aligning with Wale and Bishaw (2020) and Prananda et al. (2020), who emphasized its value in stimulating curiosity and analytical skills. A strong correlation between PBL and IBL ($r = 0.705$, $p < .01$) confirms their complementary roles, consistent with Lee and Galindo (2021). Mentoring (M = 3.87, SD = 0.83) was positively received, confirming Mullen and Klimaitis (2021), Hairon et al. (2020), and Stoeger et al. (2021), who noted its influence on trust, leadership, and decision-making. However, its direct impact on HOS was limited. While overall research activities significantly enhanced HOS ($\beta = 0.79$, $p < .01$; $R^2 = 0.62$), mentoring showed a weak relationship ($\beta = 0.10$, $p = .04$), diverging from Krishna et al. (2020) and Afandi (2021). SEM analysis also showed no direct path from mentoring to HOS, differing from Gruber et al. (2020) and Pollard and Kumar (2021). This may be due to contextual differences, including rural-urban disparities, access to skilled mentors, and varying formalization of mentoring programs. Unlike prior studies that examined mentoring independently (e.g., Gruber et al., 2020), this research integrated it within broader research activities, possibly reducing its standalone effect. Cultural and institutional factors may also hinder its alignment with academic goals. As suggested by Shanks et al. (2022) and Paseka et al. (2023), mentoring must be better integrated with research-based strategies to optimize its role in developing HOS.

Conclusion

This study provides valuable insights into the role of ROA such as Project-Based Learning (PBL), Inquiry-Based Learning (IBL), and mentoring in fostering higher-order skills (HOS) among students. The findings confirm the effectiveness of PBL and IBL as transformative learning strategies, demonstrating their ability to promote critical thinking, creativity, and problem-solving skills through active engagement and real-world applications. The strong correlation between PBL and IBL highlights their complementary nature, emphasizing the potential benefits of integrating these approaches to enhance student learning outcomes. However, while mentoring plays a supportive role, its direct impact on HOS appears limited, underscoring the need for its alignment with structured, research-driven educational frameworks. The study also identifies areas for improvement and gaps that require attention. For instance, the limited influence of mentoring on HOS suggests that mentoring practices need

to be refined to support cognitive skill development better. Factors such as geographic context, population diversity, and variations in educational resources and mentoring frameworks contribute to these discrepancies.

Additionally, the absence of a significant direct link between mentoring and HOS highlights the importance of integrating mentoring with inquiry-based and project-based strategies to maximize its impact. These findings underscore the importance of adopting a holistic approach to education that combines PBL, IBL, and mentoring to develop students' higher-order competencies. Well-structured policies, targeted teacher and mentor training programs, and equitable resource access should support such an approach. Moreover, addressing gaps in integrating ROA with educational practices can help create more inclusive and effective learning environments. By fostering critical thinking, creativity, and problem-solving skills, these strategies prepare students to navigate the complexities of the modern world, equipping them with the tools to succeed in diverse academic, professional, and societal contexts.

Recommendations

Based on the findings of this study, several recommendations are proposed for stakeholders involved in education, including policymakers, educators, mentors, and students, to enhance the development of higher-order skills (HOS) through ROA.

1. Teachers should incorporate PBL and IBL into lesson plans to promote critical thinking, creativity, and problem-solving, using real-world projects and student-driven inquiry.
2. Institutions should provide digital tools, research resources, and collaborative spaces to support the implementation of research-oriented learning activities.
3. Policy makers should mandate the integration of PBL and IBL in national curricula and fund teacher training focused on higher-order thinking skills development.
4. Mentors should align mentoring with research-based activities like PBL and IBL, offering targeted guidance to support students' analytical and creative skill growth.
5. Finally, students should actively participate in research-based activities and seek mentorship opportunities that align with their academic and professional goals.

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