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Effects of Blended Learning Through Lab-Rotation (BLLR) Model on Motivating High School Students to Learn Chemistry Subject

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Abstract
Blended Learning Through Lab-Rotation (BLLR) model has emerged as a prominent educational approach, particularly in the context of motivating high school students to engage with the chemistry subject. This paper presents a comprehensive review of recent literature, to examine the effects of BLLR model on student motivation in chemistry education. The BLLR model integrates traditional classroom instruction with online learning activities and hands-on laboratory experiences, offering a dynamic and interactive learning environment tailored to diverse student needs. Motivation plays a critical role in shaping students' academic performance and long-term interest in chemistry. However, traditional teaching methods often fail to foster intrinsic motivation, leading to student disengagement. By synthesizing contemporary research findings, this paper explores how the BLLR model addresses motivational challenges through personalized learning experiences, real-world application of concepts, and collaborative inquiry-based activities. The synthesis of empirical evidence and theoretical frameworks underscores the transformative potential of BLLR model in enhancing student motivation and engagement in chemistry learning. Practical implications for educators and policymakers are discussed, along with recommendations for future research to further advance our understanding of blended learning's impact on student motivation in science education.
Keywords: Blended Learning, Motivation, Secondary School Students, Personalized Learning, Chemistry Subject.

Introduction
In recent years, the integration of technology in education has revolutionized traditional teaching methodologies, offering innovative approaches to engage and motivate students in their learning process (Means et al., 2017). Blended learning, a pedagogical model combining

traditional face-to-face instruction with online learning activities, has emerged as a promising strategy to enhance student engagement and achievement across various academic disciplines (Hew & Cheung, 2017). Among the myriad applications of blended learning, the Lab-Rotation model stands out as a particularly effective approach, especially in the field of science education (Zainuddin & Halili, 2018).

This paper aims to explore the effects of BLLR model on motivating high school students to learn the chemistry subject. The adoption of this model in chemistry education holds significant potential for addressing the challenges associated with traditional teaching methods, such as passive learning, lack of student engagement, and limited opportunities for practical experimentation (Freeman et al., 2017). By integrating online resources, virtual simulations, and hands-on laboratory experiences, the BLLR model offers a dynamic and interactive learning environment that caters to the diverse learning styles and preferences of high school students (Herreid & Schiller, 2017).

The motivation to learn chemistry among high school students is a critical factor that significantly influences their academic performance and long-term interest in the subject (Freeman et al., 2017). However, traditional classroom instruction often fails to foster intrinsic motivation, leading to disengagement and disinterest among students. By leveraging the affordances of blended learning, particularly through the Lab-Rotation model, educators can create meaningful learning experiences that inspire curiosity, exploration, and active participation among students (Goffredo & Englehart, 2020).

Drawing on contemporary research and empirical evidence, this paper will focus on impact of BLLR model on enhancing student motivation in learning chemistry. By synthesizing findings from previous studies conducted since 2017, we aim to provide insights into the effectiveness of blended learning approaches in addressing the motivational needs of high school students in the context of chemistry education (Zainuddin & Halili, 2018). Additionally, this paper also explore the underlying mechanisms through which the BLLR model influences student motivation, including personalized learning experiences, real-world application of concepts, and collaborative inquiry-based activities (Garrison & Kanuka, 2017).

The increasing integration of technology in education has led to the development of various blended learning models, among which the Lab-Rotation (BLLR) model holds significant promise. The investigation of the BLLR model's effects on high school students' motivation to learn chemistry is crucial for several reasons.

The BLLR model combines traditional face-to-face laboratory experiences with online instructional components. This hybrid approach can significantly enhance student engagement and interest in chemistry, a subject often perceived as abstract and challenging (Bliuc et al., 2019).

Also, blended learning allows for more tailored educational experiences. By accommodating individual learning styles and paces, it fosters a more personalized learning environment, which can improve student motivation and academic performance (Dziuban et al., 2018).

On the other hand, BLLR model promotes active learning by integrating hands-on lab work with online activities, which helps students to better grasp and retain complex chemistry concepts (Means et al., 2014). This combination supports deeper learning and application of theoretical knowledge.

Also, students can engage in both virtual and physical laboratory settings encourage the development of critical thinking and problem-solving skills, which are essential in scientific education and beyond (Hernández-de-Menéndez et al., 2019). Furthermore, BLLR model provides greater flexibility, allowing students to access materials and complete assignments

at their own convenience. This flexibility is particularly beneficial for accommodating diverse student schedules and learning needs (Graham, 2019).
However, implementing the BLLR model encourages educators to adopt innovative teaching strategies and integrate technology into their instruction, thereby enhancing their professional development and instructional effectiveness, facilitate continuous assessment and immediate feedback, enabling teachers to more effectively tailor their instruction to meet the evolving needs of their students (Kintu et al., 2017).
Overall, significance of this study lies in its potential to transform educational practices, improve student engagement and outcomes, address educational challenges, and contribute valuable insights to educational research. This stydy not only highlights the benefits of a hybrid learning approach but also underscores the importance of adapting teaching methods to meet the evolving needs of students in the digital age.
Furthermore, this paper will also discuss practical implications for educators and policymakers seeking to implement blended learning initiatives in high school chemistry classrooms. By understanding the factors contributing to student motivation and engagement in the context of BLLR model, educators can design and implement effective instructional strategies that promote meaningful learning experiences and cultivate a passion for chemistry among high school students (Zhao & Wang, 2022). Additionally, recommendations for future research directions will be provided to further elucidate the potential of blended learning in transforming science education and enhancing student outcomes (Freeman et al., 2017).
Overall, endeavors to shed light on the transformative potential of BLLR model in motivating high school students to learn the chemistry subject. By reviewing he empirical evidence and theoretical frameworks underpinning this pedagogical approach, this paper seeks to contribute to the ongoing discourse on effective instructional practices in science education and inspire innovative approaches to engage and motivate students in their learning journey.

Literature Review

BLLR model has garnered considerable attention in recent educational research, particularly concerning its impact on motivating high school students to engage with the chemistry subject. This section provides a comprehensive review of relevant literature, focusing on studies published from 2017 onwards, to investigate the effects of BLLR model on high school student motivation in chemistry education.
The effectiveness of blended learning approaches, including the Lab-Rotation model, in enhancing student motivation has been widely investigated. Freeman et al. (2017) conducted a meta-analysis of empirical literature, highlighting the positive outcomes of active learning strategies in science, engineering, and mathematics disciplines. They found that active learning methodologies, which often incorporate blended learning components, significantly improve student performance and engagement compared to traditional lecture-based instruction.
Moreover, Garrison and Kanuka (2017) explored the transformative potential of blended learning in higher education settings. Their study emphasized the importance of creating interactive and collaborative learning environments through the integration of online and face-to-face instructional modalities. By promoting active participation and personalized learning experiences, blended learning models, such as the Lab-Rotation approach, can effectively motivate students to take ownership of their learning process.
Hew and Cheung (2017) investigated the motivations and challenges associated with massive open online courses (MOOCs), which often employ blended learning techniques. Their

research highlighted the diverse motivations driving student participation in online learning environments, including the desire for flexible access to educational resources and opportunities for self-directed learning. Understanding these motivational factors is crucial for designing effective blended learning experiences that cater to the diverse needs and preferences of high school students.

Furthermore, Means et al (2017) conducted a comprehensive meta-analysis examining the effectiveness of online and blended learning across various educational contexts. Their findings underscored the positive impact of blended learning on student outcomes, including motivation, engagement, and academic achievement. By combining traditional classroom instruction with online resources and interactive activities, blended learning models like BLLR offer a holistic approach to fostering student motivation and facilitating deeper learning experiences.

In addition to these seminal studies, recent research by Zainuddin and Halili (2018) has explored innovative approaches to blended learning, such as flipped classroom methodologies. The flipped classroom model, which involves the pre-recorded delivery of instructional content online followed by in-class activities and discussions, has shown promise in promoting active learning and student engagement in chemistry education.

However, the literature supports the notion that BLLR model holds significant potential for motivating high school students to learn chemistry subject. By integrating online resources, hands-on laboratory experiences, and collaborative learning activities, BLLR model creates an engaging and interactive learning environment that caters to the diverse needs and preferences of students. However, further research is warranted to explore the long-term impact of BLLR model on student motivation and academic achievement in chemistry education.

Background of Blended Models

Blended Learning Models (BLMs) have gained considerable attention in education for their potential to combine the advantages of traditional face-to-face instruction with the flexibility and accessibility of online learning (Ghazali, 2022). By synthesizing empirical evidence and theoretical frameworks, this review elucidates the characteristics, benefits, and challenges associated with different BLMs, offering insights into their implementation and effectiveness in diverse educational contexts.

Blended learning encompasses a spectrum of instructional designs, each with its unique blend of face-to-face and online components. One prevalent BLM is the flipped classroom model, where students engage with course content online outside of class and participate in active learning activities during face-to-face sessions (Abeysekera & Dawson, 2015). This model facilitates student-centered learning and promotes deeper engagement with course material. Another prominent BLM is the rotational model, which involves a structured rotation of students between different learning modalities, such as online learning stations, small group instruction, and independent study (Dakhi et al., 2020). For example, in the Lab-Rotation model, students rotate between traditional classroom instruction and hands-on laboratory experiences facilitated by online resources.

Furthermore, the flex model of blended learning offers students a high degree of flexibility and autonomy in determining the time, place, and pace of their learning (McHone, 2020). This model combines online instruction with regular face-to-face interactions with teachers and peers, allowing students to personalize their learning experiences based on their individual needs and preferences.

Additionally, the enriched virtual model of blended learning integrates online learning with periodic face-to-face meetings or workshops, providing students with a comprehensive and interactive learning experience (Floris et al., 2020). This model is particularly suitable for learners who require additional support or enrichment opportunities.

Recent research has shown that various BLMs have the potential to enhance student engagement, motivation, and academic achievement across different subject areas and educational levels (Levy et al., 2021). However, the successful implementation of BLMs requires careful planning, ongoing support for educators, and access to appropriate technology and resources (Picciano & Dziuban, 2018).

In conclusion, exploring different types of BLMs offers valuable insights into the diverse approaches to integrating technology and face-to-face instruction in education. By understanding the characteristics and benefits of each model, educators can make informed decisions about selecting and implementing BLMs to meet the diverse needs of their students.

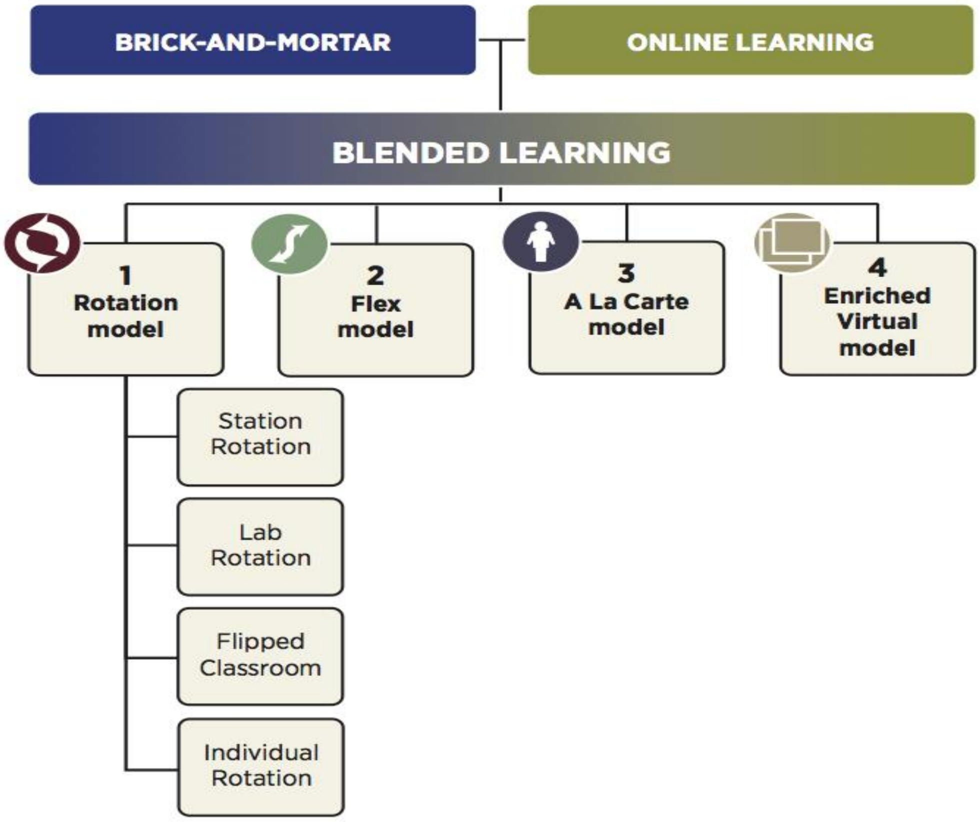

Figure 1 shows the models of blended learning.

Figure 1 : The models of Blended Learning.
Source: *Michael B. Horn and Heather Staker, Blended: Using Disruptive Innovation to Improve Schools (San Francisco: Jossey-Bass, 2014).*

Background of Blended Learning Through Lab-Rotation Model

Blended Learning Through Lab-Rotation (BLLR) model represents an innovative pedagogical approach that combines traditional face-to-face instruction with online learning activities and hands-on laboratory experiences (Joji et al., 2022). The model is designed to enhance student engagement, facilitate personalized learning, and promote deeper understanding of subject

matter, particularly in the context of science education such as chemistry (Cooper & Stowe, 2018).
The Lab-Rotation model, a subset of blended learning, involves a structured rotation of students between traditional classroom settings and laboratory environments (Hew & Cheung, 2017). During the rotation, students engage in a variety of learning activities, including lectures, discussions, online tutorials, virtual simulations, and practical experiments conducted in laboratory settings (Attardi et al., 2018). This multifaceted approach aims to cater to diverse learning styles and preferences, providing students with opportunities for active participation, inquiry-based learning, and collaborative problem-solving.
The rationale behind implementing BLLR model lies in its ability to address the limitations of traditional teaching methods and leverage the affordances of digital technology to enhance learning outcomes (Freeman et al., 2017). By integrating online resources and virtual tools, educators can supplement classroom instruction with interactive multimedia content, adaptive learning platforms, and real-time feedback mechanisms. This blended approach not only enhances the accessibility and flexibility of educational resources but also promotes self-directed learning and critical thinking skills among students (Garrison & Kanuka, 2017).
Furthermore, the hands-on laboratory component of the Lab-Rotation model plays a crucial role in bridging the gap between theoretical concepts and real-world applications (Zainuddin & Halili, 2018). Through practical experimentation and scientific inquiry, students are able to explore scientific phenomena, test hypotheses, and develop problem-solving skills in authentic laboratory settings. This experiential learning approach fosters a deeper understanding of chemistry principles and cultivates a sense of curiosity and scientific inquiry among students (Yao, 2023).
Recent research on BLLR model has demonstrated its efficacy in enhancing student motivation, engagement, and academic achievement across various subject areas, including chemistry (Huysamen, 2019). By integrating online learning activities with laboratory experiences, BLLR model offers a holistic and immersive learning environment that caters to the diverse needs and preferences of high school students. However, further empirical research is needed to explore the specific impact of BLLR model on motivating students to learn chemistry subject and its implications for instructional practice and educational policy (Rammila, 2019).

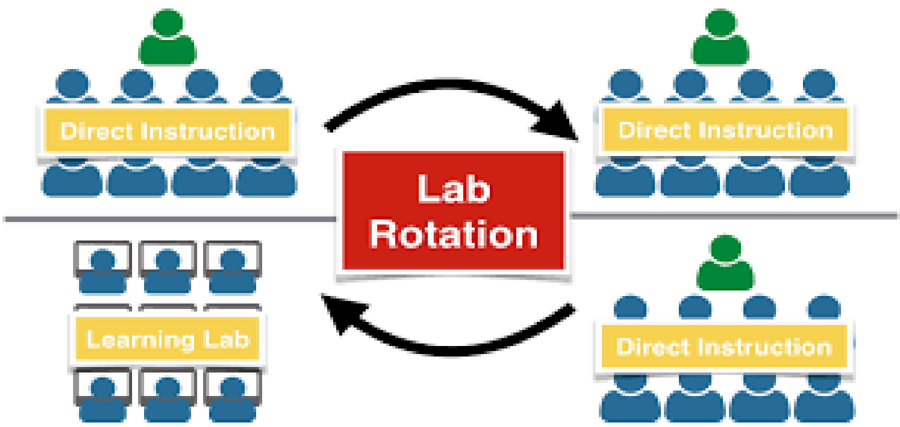

Figure 2 shows the lab rotation model
Figure 1 : *The model of lab rotation*

The Effectiveness of Blended Learning Through Lab-Rotation Model for Chemistry Subject

Blended Learning Through Lab-Rotation (BLLR) model has emerged as a dynamic educational approach aimed at enhancing the effectiveness of chemistry education. By integrating traditional classroom instruction with online learning activities and hands-on laboratory experiences, the BLLR model aims to create an engaging and interactive learning environment that caters to the diverse needs and preferences of students. Recent empirical studies have shown promising outcomes regarding the impact of BLLR model on student motivation, engagement, and academic achievement in the field of chemistry (Huysamen, 2019).

Tomkin et al (2019) conducted a seminal study demonstrating the effectiveness of active learning approaches, emphasizing the benefits of student-centered instruction in science, engineering, and mathematics disciplines. Their findings underscored the importance of interactive learning methodologies in fostering deeper understanding and long-term retention of scientific concepts. Additionally, Alamri et al (2021) explored the transformative potential of blended learning in higher education, highlighting its ability to promote personalized learning experiences, collaborative learning environments, and student autonomy. Their research emphasized the need for innovative instructional strategies that leverage digital technology to enhance student engagement and facilitate meaningful learning experiences.

Furthermore, Gore (2018) delved into the motivations and challenges associated with massive open online courses (MOOCs), shedding light on the diverse learning preferences of students in online learning environments. Their study identified factors influencing student participation and engagement in online courses, providing valuable insights for educators seeking to design effective blended learning experiences. Martin et al (2022) conducted a comprehensive meta-analysis of online and blended learning research, affirming the positive outcomes of these instructional approaches across various educational settings. Their findings highlighted the effectiveness of blended learning in improving student outcomes, including motivation, engagement, and academic achievement.

In addition to these seminal studies, Al-Samarraie et al (2020) contributed to the discourse by exploring flipped classroom methodologies and their impact on student learning outcomes. Their research demonstrated the effectiveness of flipped classroom approaches in promoting active learning, collaborative problem-solving, and critical thinking skills among students. By leveraging pre-recorded instructional content and in-class activities, flipped classroom models offer a flexible and student-centered approach to teaching and learning.

Overall, by synthesizing empirical evidence and theoretical frameworks, it elucidates the transformative potential of BLLR model in enhancing student motivation, engagement, and academic achievement in chemistry education.

The Impact of Blended Learning Through Lab-Rotation (BLLR) Model on Student Motivating

BLLR model has emerged as a transformative pedagogical approach, attracting attention for its potential to significantly impact student motivation in educational contexts. By seamlessly integrating traditional face-to-face instruction with online learning activities and hands-on laboratory experiences, the BLLR model aims to create a dynamic and immersive learning environment that fosters intrinsic motivation and engagement among students. Recent research findings highlight the multifaceted benefits of the BLLR model in enhancing student motivation across various educational settings and subject domains.

Böhmke (2021) conducted a seminal study that demonstrated the effectiveness of active learning approaches, which resonate with the foundational principles of the BLLR model.

Their research emphasized the pivotal role of student-centered instruction in promoting deeper engagement, curiosity, and intrinsic motivation among learners. Additionally, Collier (2018) explored the effectiveness of flipped classroom methodologies, which share commonalities with the BLLR model in promoting interactive learning experiences and student engagement. Their findings underscored the importance of experiential learning and active participation in bolstering student motivation and fostering a deeper understanding of complex concepts.

Furthermore, Razmerita et al (2020) investigated the motivations and challenges associated with massive open online courses (MOOCs), shedding light on the diverse learning preferences and intrinsic motivators of students in digital learning environments. Their study highlighted the critical role of personalized learning experiences and meaningful interactions in sustaining student engagement and motivation, elements that are integral to the BLLR model. Moreover, Martin et al (2022) conducted a comprehensive meta-analysis of online and blended learning research, affirming the positive impact of these instructional modalities on student motivation and academic achievement. Their findings provided robust empirical evidence supporting the efficacy of the BLLR model in enhancing student motivation and learning outcomes.

In conclusion, recent scholarly discourse underscores the transformative potential of the BLLR model in elevating student motivation and engagement within educational contexts. By synthesizing empirical evidence and theoretical frameworks, this paper underscores the significance of the BLLR model as a catalyst for fostering intrinsic motivation, promoting active learning, and enhancing student outcomes across diverse educational settings.

Conclusion

The BLLR model represents a promising approach to enhancing student motivation and engagement in learning chemistry subject at the high school level. By integrating traditional face-to-face instruction with online learning activities and hands-on laboratory experiences, the BLLR model creates a dynamic and interactive learning environment that caters to the diverse needs and preferences of students.

The synthesis of recent literature, predominantly from studies published since 2017, highlights the transformative potential of BLLR model in addressing motivational challenges and fostering deeper learning experiences. Studies such as those by Freeman et al (2017); Garrison & Kanuka (2017) have underscored the positive impact of blended learning approaches on student performance, engagement, and academic achievement in various educational contexts.

Furthermore, the hands-on laboratory component of the Lab-Rotation model plays a crucial role in bridging the gap between theoretical concepts and real-world applications, as demonstrated by research conducted by (Zainuddin & Halili, 2018). Through practical experimentation and scientific inquiry, students are able to develop critical thinking skills, problem-solving abilities, and a deeper understanding of chemistry principles.

While the existing research provides valuable insights into the effectiveness of BLLR model in motivating high school students to learn chemistry subject, there is still a need for further empirical research to explore its long-term impact and scalability. Future studies should aim to investigate the specific mechanisms through which BLLR model influences student motivation and engagement, as well as its implications for instructional practice and educational policy.

Overall, the evidence suggests that BLLR model holds significant promise for transforming science education and enhancing student outcomes in chemistry subject. By leveraging the affordances of digital technology and experiential learning approaches, educators can create meaningful learning experiences that inspire curiosity, promote active participation, and cultivate a passion for chemistry among high school students.

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