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Empowering STEM Education:
Navigating Challenges and Embracing Innovations

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Abstract

This article exposes the main arguments of each article published in this issue. In Tara Brabazon's article, the focus is on addressing student attrition in universities, advocating for strategies like universal design and the abundance model to support student success. Lineo Lynnette Tool's study in South African universities explores underrepresented groups in STEM leadership, suggesting that targeted efforts can encourage their ascent, using a mixed-methods approach. Asmera Teshome Negeri and Jeilu Oumar's article from Addis Ababa University investigates the gap between engineering graduate skills and employers' needs in Ethiopia, emphasizing the importance of real labor market skills assessments and practical-oriented teaching. Dominic Patric G. Galdonez's research at the Philippine Science High School-Ilocos Region Campus highlights mixed perceptions of research support and strong motivation among teachers for research-related activities. Khut Sokha and Shimizu Kinya's study establishes a framework for teaching science through an integrated STEM approach (ISTEMA), identifying six elements and exploring the integration of science with engineering and technology in primary and lower secondary education. Ethel Reyes-Chua, et.al., from Paranaque City College, delve into metacognitive strategies employed by college students in the Philippines during the pandemic, emphasizing self-motivation and students' resilience. Sunil Dehipawala, et.al., address challenges in teaching measurement uncertainty in physics lab classes during the Covid-19 pandemic, providing insights into experiential learning and assessment rubrics for remote delivery. Prasart Nuangchalerm & Veena Prachagool's paper discusses the integration of AI in STEM education, analyzing transformative potential of AI-driven learning analytics, highlighting the need for ethical considerations in implementing technological innovations.

Keywords: *STEM Education, Experiential Learning, Educational Inclusivity, Teacher Research,Industry-Education Alignment*

INTRODUCTION

The current issue of the journal delves deep into the multifaceted landscape of STEM education, shedding light on critical aspects such as student success, inclusivity in STEM leadership, the evolving role of teachers as researchers, and the essential alignment of education with industry needs. The exploration of these themes provides a comprehensive understanding of the challenges and opportunities that shape the future of STEM education.

The essay on student success and inclusive teaching models begins by highlighting the intricacies of student success, recognizing that these achievements extend beyond mere academic metrics. Brabazon et al. (2023) from Flinders University of South Australia emphasizes the hidden stories behind student attrition figures, arguing that universities often fail to address the underlying issues adequately. The article advocates for a paradigm shift from the traditional deficit model of teaching and learning to universal design and the abundance model. This approach focuses on creating inclusive learning environments that cater to diverse student needs, thereby reshaping the landscape of science education.

Next focus is he underrepresentation of certain demographic groups in STEM leadership roles. (KHUT & Shimizu, 2023; Kusmawan, 2022; Nugroho et al., 2019) study, conducted through a convergent sequential

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mixed method, sheds light on the lack of diversity in leadership within STEM fields in South African universities. The research advocates for targeted and culturally informed collaborative efforts to break down barriers, with the findings suggesting that specific development programs can pave the way for underrepresented demographics to ascend to leadership positions.

Moving beyond student perspectives, the essay explores the evolving role of teachers as researchers. Galdonez (2023) study at the Philippine Science High School-Ilocos Region Campus highlights the multifaceted role of teachers, extending beyond the classroom. The research unveils the nuanced dynamics of teacher involvement in research activities, emphasizing their contribution to the advancement of teaching and learning through active engagement in educational research.

Simultaneously, Teshome & Oumar (2023) study delves into the mismatch between skills acquired by engineering graduates and industry needs in Ethiopia. The research advocates for collaborative efforts between universities and employers to conduct real labor market skills' needs assessments, recommending a shift in curriculum delivery to ensure graduates acquire the skills demanded by employers.

The article proceeds to propose an Integrated STEM Approach (ISTEMA) as a framework for daily STEM education. KHUT & Shimizu (2023) present a systematic literature review identifying six key elements of ISTEMA: inquiry-based, engineering-based, technology-based, problem-based, teamwork-based, and robotic-based learning. The study contributes to the ongoing discourse on STEM education by providing a framework that guides educators in implementing integrated STEM approaches.

Shifting the focus to metacognition in Philippine higher education, Reyes-Chua et al. (2023) study explores the metacognitive strategies employed by college students. The research reveals that self-motivation is the predominant metacognitive strategy among students, showcasing their resilience in navigating educational challenges amid the pandemic. The study emphasizes the importance of a more comprehensive understanding and integration of metacognitive strategies in educational practices.

Next, in response to the challenges posed by the Covid-19 no-access policy, the essay discusses the experiences of remote learning in physics lab classes. (Dehipawala et al., 2023; Kusmawan, 2022) research collaboration explores the remote delivery of experiential learning, offering practical examples and assessment rubrics for navigating challenges in physics education during the ongoing pandemic (Dehipawala et al., 2023).

Lastly, the essay reflects on the transformative potential of AI-driven learning analytics in STEM education. Nuangchalerm's paper from Mahasarakham University, Thailand, delves into the ethical considerations and possible threats associated with implementing technological innovations in the classroom. The study serves as a valuable resource for educators, researchers, and policymakers seeking to harness the power of AI-driven learning analytics while ensuring ethical considerations are at the forefront of educational advancements (Nuangchalerm, 2023).

Each theme and study featured in this issue has been selected and analyzed through our systematic review process, ensuring that we present a well-rounded and insightful overview of the current trends and future directions in STEM education.

Editorial Objectives

In this editorial article, we embark on a comprehensive exploration of various dimensions within the sphere of STEM education. Our objective is to dissect and integrate a multitude of perspectives, ranging from classroom dynamics and leadership inclusivity to the interplay between educational frameworks and evolving industry demands. We delve into these themes to not only reflect upon the current state of STEM education but also to project future pathways for its development. The following objectives guide our discourse:

1. To critically analyze and synthesize contemporary research and practices in STEM education, focusing on student success, inclusivity in leadership, and the pivotal role of teachers as researchers in bridging the educational-industry gap.
2. To explore the implementation of Integrated STEM Approaches (ISTEMA), metacognition strategies, and the impact of remote learning on physics education, thereby providing insights into effective teaching methodologies and student engagement during the Covid-19 pandemic.
3. To evaluate the challenges and opportunities presented by AI-driven learning analytics in STEM education, with a particular emphasis on ethical considerations, to guide educators, researchers, and policymakers in making informed decisions for the future of STEM learning.

STUDENT SUCCESS, INCLUSIVITY IN STEM LEADERSHIP, AND TEACHERS AS RESEACHERS: Bridging the Gap Between Education and Industry Needs

Brabazon et al. (2023) insightful exploration at Flinders University of South Australia unravels the layers hidden within student attrition figures, transforming them from mere statistics into profound indicators of unaddressed challenges within universities. Brabazon argues that these figures go beyond signaling institutional failure; they hinder branding and marketing efforts, often deflecting blame onto individual students. The narratives concealed behind these numbers reveal stories of shame, guilt, failure, confusion, and shattered dreams. In response, Brabazon's article endeavors to expose these hidden narratives and, more importantly, to discover innovative strategies that can effectively support student success.

The article takes a critical stance towards the traditional deficit model of teaching and learning, which places the responsibility on students to bridge perceived gaps. Brabazon advocates for a paradigm shift towards universal design and the abundance model of teaching and learning. This shift aims to create inclusive learning environments that cater to the diverse needs of students, acknowledging that a one-size-fits-all approach is insufficient in today's educational landscape.

The article emphasizes the pivotal role of well-qualified university academics in reshaping the landscape of science education. By aligning innovative research with teaching practices, academics can contribute significantly to creating a more dynamic and responsive educational system. Brabazon underscores the importance of integrating cutting-edge research into the curriculum, ensuring that students are exposed to the latest developments in their respective fields.

Moving beyond the goal of mere retention, Brabazon proposes a more ambitious objective – to actively engage and empower students. The article introduces methodologies that seek to understand and facilitate productive pathways through the curriculum. It envisions an educational system where both students and educators thrive, emphasizing that student success is not just an individual responsibility but a collective endeavor. This vision underscores the interconnectedness of student success with the broader educational ecosystem (Brabazon et al., 2023).

Next, Lineo Lynnette Tool, from the Department of Educational Leadership and Management at the University of South Africa, delves into the intricate issue of the lack of representation of underrepresented groups in leadership roles within STEM fields. Her study, employing a convergent sequential mixed method, recognizes this as a critical concern that demands immediate attention. Tool's research takes a comprehensive approach by utilizing questionnaires, interviews, and statistical documents to paint a vivid picture of the challenges faced by underrepresented groups in South African universities aspiring to take on leadership roles in STEM fields. Through this thorough exploration, the study sheds light on the multifaceted barriers and

identifies potential opportunities for the advancement of underrepresented demographics in STEM leadership roles.

A central theme in Tool's study is the call for targeted and culturally informed collaborative efforts to break down the barriers that hinder the progression of underrepresented groups (Bautista-Cerro Ruiz et al., 2017). The research advocates for inclusivity not only as a moral imperative but as a strategic necessity for the development and progress of STEM fields. By emphasizing the need for collaboration, the study recognizes that a collective effort is essential to bring about meaningful change in the representation landscape. Tool's findings suggest that specific development programs tailored to the unique challenges faced by underrepresented demographics can effectively pave the way for their ascent to leadership positions. This insight highlights the importance of targeted initiatives that address the specific needs and hurdles faced by individuals from underrepresented groups, acknowledging that a one-size-fits-all approach is inadequate.

The implications of Tool's study extend far beyond the confines of individual universities. The identified strategies offer a blueprint for fostering inclusivity and equality in STEM leadership roles across various educational institutions. By recognizing and addressing the systemic issues, the study provides a roadmap for creating environments where individuals from all backgrounds have equal opportunities to contribute and lead in STEM disciplines.Tool's research underscores the significance of a collective commitment to creating opportunities for all, irrespective of background or identity. It emphasizes that true inclusivity requires a united effort from academia, industry, and policymakers to dismantle existing barriers and create a more level playing field for aspiring leaders in STEM. In summary, Lineo Lynnette Tool's study contributes valuable insights and actionable strategies to tackle the issue of underrepresentation in STEM leadership roles, paving the way for a more inclusive and diverse future in these critical fields.

The next article by Dominic Patric G. Galdonez, hailing from the Philippine Science High School-Ilocos Region Campus, offers a compelling exploration into the dynamics of teachers' roles and their impact on students' success and leadership in STEM education. His study, driven by the understanding that education is an ever-evolving field demanding innovative teaching methods, focuses on the pivotal role of teachers and the potential enhancement of STEM education through meaningful research. Galdonez's study recognizes teachers as the architects of education, playing a multifaceted role that extends beyond the traditional boundaries of the classroom. By delving into the experiences and perceptions of teachers at the Philippine Science High School-Ilocos Region Campus, the research sheds light on the intricate dynamics that shape the educational landscape.

Employing a quantitative research approach, Galdonez's study provides a systematic examination of the nuanced dynamics of teacher involvement in research activities. By quantifying perceptions, motivations, and skills, the research offers a detailed understanding of the factors that influence teachers' engagement in meaningful research endeavors. This quantitative lens contributes valuable empirical evidence to the broader discourse on the role of teachers in shaping STEM education. Galdonez's findings bring to the forefront the mixed perceptions of teachers regarding research support. Some may find robust support systems, while others might face challenges. Despite these variations, the study reveals an unwavering motivation among teachers to contribute meaningfully to educational research. This duality of experiences underscores the complexity of the educational landscape and emphasizes the dedication of educators to advance their profession.

The study highlights commendable skills among teachers in planning and writing research papers. Galdonez's research underscores the competency of teachers in translating their experiences and insights into scholarly contributions. This not only enhances their professional development but also contributes to the collective knowledge base in STEM education.Galdonez's study provides valuable insights for educators and institutions seeking to enhance research engagement and productivity among teaching staff. By understanding

the factors that influence teachers' involvement in research, institutions can tailor support mechanisms to address specific needs, fostering a culture of continuous improvement and scholarship among educators.

The research emphasizes the pivotal role teachers play not only in imparting knowledge but also in contributing to the advancement of teaching and learning through active engagement in educational research. By actively participating in research activities, teachers become catalysts for positive change, driving innovation and improvement in STEM education. In conclusion, Dominic Patric G. Galdonez's study enriches our understanding of the multifaceted role of teachers in STEM education. It provides a roadmap for institutions and educators to foster a culture of research engagement, ultimately contributing to the success and leadership development of students in the dynamic field of STEM education.

Lastly, in the ever-evolving landscape of STEM education, the exploration of students' success, leadership development, and teachers as researchers lays a foundation for addressing the critical gap between education and industry needs. Asmera Teshome Negeri and Jeilu Oumar, scholars from the College of Education and Behavioral Studies at Addis Ababa University, Ethiopia, contribute significantly to this discourse by delving into the challenges posed by the mismatch between the skills acquired by engineering graduates and the demands of the labor market. Negeri and Oumar's study contextualizes the challenges within the context of a rapidly changing global landscape where the demand for relevant skills and competences has surged. The dynamic nature of industries necessitates a comprehensive understanding of the skill gaps hindering graduates from seamlessly transitioning into the workforce.

Employing a rigorous mixed-methods approach, the research meticulously exposes the gaps in academic, technical, interpersonal, and generic skills. This comprehensive examination provides a nuanced understanding of the specific areas where graduates may lack alignment with industry expectations. The qualitative insights complement quantitative data, offering a holistic view of the skills landscape. The findings underscore the imperative for universities and employers to engage in collaborative efforts to conduct real labor market skills' needs assessments. This collaboration is not merely a recommendation but a strategic imperative to bridge the existing gaps effectively. By fostering a dialogue between academia and industry, institutions can tailor their educational programs to meet the evolving demands of the job market. One key recommendation emerging from the study is a paradigm shift in curriculum delivery. Moving away from theory-focused approaches, the study advocates for a practical-oriented teaching methodology. This shift ensures that graduates not only possess theoretical knowledge but also acquire hands-on, applicable skills that directly align with the needs of the industry. Such a pedagogical transformation is essential for producing graduates who are not only academically competent but also professionally adept.

The study emphasizes the significance of establishing strong and sustainable linkages between industries and training institutes. These linkages serve as conduits for the exchange of insights, expectations, and expertise between academia and the job market. By fostering these connections, educational institutions can gain real-time insights into industry needs, allowing for agile adjustments in curricula to meet current and future demands. Negeri and Oumar's research serves as a powerful call to action for educational institutions and employers. It urges a collaborative approach in preparing graduates for the dynamic and competitive job market. The study underscores that the alignment of education with workforce needs is not a singular responsibility but a collective endeavor, requiring active participation from both academia and industry stakeholders. Ultimately, the collaborative efforts recommended by the study are positioned as catalysts for economic growth and innovation. Graduates equipped with skills tailored to industry demands become valuable contributors to the workforce, driving innovation and fueling economic development. In conclusion, Negeri and Oumar's study provides a roadmap for addressing the gap between education and industry needs. By understanding and acting upon the identified skill disparities, educational institutions can play a pivotal role in

preparing graduates who are not only academically proficient but also well-equipped for the challenges and opportunities of the professional world.

INTEGRATED STEM EDUCATION, METACOGNITION, REMOTE LEARNING, AND LEARNING ANALYTICS

While the aforementioned four articles relate to socio-cultural aspects of STEM education, the rest four articles went down to more daily conduct of how STEM education could more prudently conveyed. In the realm of STEM education, where the socio-cultural landscape intersects with the daily conduct of teaching and learning, Khut Sokha and Shimizu Kinya, scholars from the Faculty of Humanity and Social Science at Hiroshima University, Japan, make a significant contribution through their exploration of the Integrated STEM Approach (ISTEMA). Their study not only acknowledges the recognized importance of integrating science, technology, engineering, and mathematics (STEM) in K-12 education but also addresses the persistent challenges in implementing such integration effectively. Recognizing that a seamless integration of STEM disciplines is crucial for shaping future prosperity and cultivating a skilled workforce, the study dives into the complexities of implementing an Integrated STEM Approach (ISTEMA). While the benefits of STEM integration are widely acknowledged, the study acknowledges the existing challenges that hinder its effective implementation in educational settings.

The researchers employ a systematic literature review as a methodological tool to navigate through existing knowledge and identify gaps in the understanding of integrated STEM education. This approach ensures a comprehensive exploration of the subject matter, drawing on insights from a diverse range of scholarly works. Khut Sokha and Shimizu Kinya's study unveils the Integrated STEM Approach's well-defined framework, encompassing six key elements: inquiry-based, engineering-based, technology-based, problem-based, teamwork-based, and robotic-based learning. These elements collectively form the backbone of ISTEMA, providing a structured and comprehensive approach to teaching science across different educational levels. One notable aspect of their findings is the primary focus on primary and lower secondary education. This targeted approach recognizes the formative years of a student's education as crucial for instilling a foundational understanding of integrated STEM concepts. The variations in the integration of science subjects across different educational settings are acknowledged, allowing for a nuanced understanding of the diverse educational landscapes.

The study contributes significantly to the ongoing discourse on STEM education by not only identifying key elements but also by providing a practical framework for educators. In doing so, it addresses the need for a standardized approach that can guide teachers in implementing integrated STEM methodologies effectively. This contribution is vital in fostering a holistic learning experience for students, aligning with the broader goals of STEM education. Educators often face challenges in translating theoretical concepts into practical teaching methodologies. Khut Sokha and Shimizu Kinya's framework offers a guide for educators, providing them with tangible elements to incorporate into their teaching practices. This guidance is essential for bridging the gap between theoretical understanding and its application in the classroom. By emphasizing a holistic learning experience, the study recognizes that integrated STEM education goes beyond the silos of individual disciplines. It encourages a transdisciplinary approach that not only imparts knowledge but also cultivates critical thinking, problem-solving skills, and teamwork – essential attributes for success in STEM-related fields.

In conclusion, Sokha and Kinya's research on the Integrated STEM Approach significantly contributes to the practical implementation of STEM education. By addressing the challenges and

providing a well-defined framework, the study guides educators in creating a conducive learning environment that prepares students for the complexities of the future.

Next, Embarking on a journey from Japan to the Philippines, the exploration of metacognition takes center stage in the research conducted by Ethel Reyes-Chua and her colleagues from Paranaque City College. Their study unfolds a narrative that transcends geographical boundaries, shedding light on the pivotal role of metacognition in the context of successful learning. Focusing specifically on college students at Emilio Aguinaldo College - Cavite, Philippines, the research dives into the intricate web of metacognitive strategies and their impact on academic and personal growth. Metacognition, defined as the awareness and control of one's cognitive processes, emerges as a linchpin for effective learning. Reyes-Chua and her team recognize its significance in the academic journey and set out to unravel the metacognitive landscape of students in the unique educational setting of the Philippines.

The study, conducted using a mixed-methods research design, serves as a compass, guiding us through the metacognitive strategies employed by students. In the face of unprecedented challenges posed by the pandemic, it becomes evident that metacognition plays a crucial role in students' ability to navigate distractions and fortify their resilience. Reyes-Chua's research unveils a fascinating revelation – self-motivation emerges as the predominant metacognitive strategy among students. Despite external disruptions, students showcase an innate drive to propel themselves forward. This self-motivation becomes a powerful force, steering students through the complexities of their educational journey. The study's uniqueness lies in its exploration of metacognitive strategies within the specific context of Philippine higher education. By delving into the experiences of students at Emilio Aguinaldo College - Cavite, the research contributes original insights that transcend traditional boundaries, acknowledging the cultural and contextual nuances that shape metacognitive practices.

While the study acknowledges the limitations inherent in relying solely on self-assessment, it underscores the importance of metacognition in enhancing learning and fortifying students for future challenges. The acknowledgment of these limitations serves as a foundation for a more nuanced understanding, encouraging a continuous dialogue on refining research methodologies in metacognitive studies. Reyes-Chua's research advocates for a more comprehensive understanding and integration of metacognitive strategies into educational practices. The call is not merely to recognize metacognition as a theoretical concept but to embed it actively within the fabric of teaching and learning. This advocacy resonates not only in the Philippines but reverberates globally, emphasizing the universality of metacognition's impact on learning outcomes.

In conclusion, the journey from Japan to the Philippines in the realm of metacognition undertaken by Ethel Reyes-Chua and her colleagues paints a vivid picture of the transformative power of self-motivation and resilience in the face of challenges. This research not only contributes to the broader understanding of metacognition but also advocates for its practical integration into educational practices, transcending geographical boundaries for a global impact.

Next best practice is one innovation emerges through the collaborative research efforts of Sunil Dehipawala and his team at City University of New York Queensborough Community College, USA, in conjunction with researchers from Universitas Terbuka, Indonesia. Their groundbreaking study navigates the uncharted territory of remote learning, specifically addressing the challenges encountered in teaching and assessing measurement uncertainty in physics lab classes amid the unprecedented Covid-19 no-access policy. Conducted within the unique setting of a two-year community college, the research offers a granular perspective on the challenges faced in delivering experiential learning remotely. This context

adds a layer of complexity as the traditional tactile experiences inherent in physics lab classes are rendered inaccessible due to the constraints imposed by the ongoing global pandemic.

At the heart of this research lies the ingenious application of a transference learning process, a strategic approach to guide the remote delivery of experiential learning. This process becomes the linchpin, ensuring that the essence of hands-on experiences is not lost in translation to the virtual realm. The study meticulously dissects the nuances of transference learning, shedding light on its effectiveness in maintaining the integrity of physics education in a remote setting.The research doesn't shy away from confronting head-on the misconceptions and challenges that arise in teaching uncertainty percent calculation and graphical representation in a remote environment. By acknowledging these hurdles, the study sets the stage for a proactive and solution-oriented exploration of alternative methodologies to bridge the gap created by the absence of physical labs.

A hallmark of this research lies in its commitment to providing tangible solutions. The team, led by Dehipawala, goes beyond theoretical discussions, offering practical examples and assessment rubrics tailored for experiential learning in the remote delivery landscape. These resources become invaluable tools for educators seeking to adapt their pedagogical approaches to the constraints imposed by the Covid-19 pandemic. As higher education institutions globally grapple with the concept of the "new normal," Dehipawala's study offers timely and pertinent insights. It becomes a guiding light for universities and educators navigating the challenges of remote learning, ensuring that students not only adapt but thrive in an environment that demands innovative solutions. This research, born out of collaboration between institutions in the USA and Indonesia, transcends geographical boundaries. Its findings and methodologies become valuable contributions to the broader discourse on STEM education, emphasizing the adaptability and resilience of pedagogical practices in the face of unforeseen challenges. In conclusion, Sunil Dehipawala's research stands as a testament to the spirit of innovation in STEM education. By tackling the intricacies of remote delivery in physics lab classes, the study provides a roadmap for educators, offering practical solutions, and redefining the possibilities for experiential learning in the digital age.

Lastly, the transformative potential of Artificial Intelligence (AI) takes center stage, as eloquently explored by Prasart Nuangchalerm and Veena Prachagool from the Faculty of Education at Mahasarakham University, Thailand. Their paper delves into the profound impact of AI on STEM education, presenting a compelling narrative on the integration of AI-driven learning analytics within the educational realms. Nuangchalerm and Prachagool's work recognizes the pervasive influence of AI across diverse disciplines, with a particular focus on its intersection with STEM education. The authors paint a vivid picture of AI as a catalyst for transformative advancement, showcasing its potential to revolutionize the traditional paradigms of teaching and learning in science, technology, engineering, and mathematics.

Central to their exploration is the introduction of AI-driven learning analytics, a groundbreaking concept that harnesses the power of artificial intelligence to analyze and interpret data related to student learning. The paper meticulously details the nuances of this paradigm, shedding light on how AI can enhance the educational experience by providing personalized insights, adaptive learning pathways, and real-time feedback to students and educators. Nuangchalerm and Prachagool offer a comprehensive analysis of the transformative potential embedded within the AI-driven STEM curriculum. By dissecting the various facets of this paradigm, they present a roadmap for educators and institutions keen on embracing AI as a tool for enriching the learning environment. The paper serves as a thought-provoking guide for navigating the uncharted territory of AI integration in STEM education.

However, the authors do not shy away from acknowledging the challenges that accompany the integration of AI in education. Their work meticulously highlights potential obstacles and threats that

educators and institutions may face, ranging from technical issues to ethical dilemmas. This honest assessment serves as a crucial resource for stakeholders, offering insights into preemptive strategies and considerations in the pursuit of a seamless AI-driven educational landscape. Ethical considerations take center stage in Nuangchalerm and Prachagool's narrative. The authors underscore the moral responsibility of educators and policymakers in ensuring that the implementation of AI-driven learning analytics adheres to ethical standards. This emphasis on responsible AI usage positions their paper as a guiding beacon for those navigating the ethical complexities of data-driven education. As AI continues to reshape the educational landscape, the paper emerges not only as a scholarly contribution but as a valuable resource for educators, researchers, and policymakers alike. Nuangchalerm and Prachagool's work provides practical insights, ethical guidelines, and a forward-looking perspective, equipping stakeholders with the knowledge needed to harness the potential of AI while safeguarding the ethical integrity of STEM education.

LAST REMARKS

In conclusion, the essay advocates for a holistic and inclusive approach to STEM education, recognizing the interconnectedness of student success, inclusive teaching models, diverse leadership, teacher research engagement, skills gap closure, integrated STEM approaches, metacognition, and the responsible integration of AI-driven learning analytics. This holistic perspective aims to address challenges and foster collaboration between academia and industry, creating a dynamic and responsive STEM education ecosystem.

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