STEM Education Reform: Advancing 21st Century Learning through Action Learning Theory

Literature Review

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Introduction

Science, technology, engineering, and mathematics (STEM) are critical competencies in today's economy and society. The ability to understand and apply STEM concepts is vital for innovation and problem-solving.

However, the U.S. education system faces a STEM crisis due to outdated practices and a lack of engagement. This literature review book focuses on the three major themes of STEM education reform: connecting STEM education to relevant and meaningful experiences, developing STEM literacy in the changing U.S. demographics, and approaching the STEM crisis through organizational leadership.

The book advocates for a transformative approach to STEM education using action learning theory. Action learning involves learning by doing and solving real-world challenges in a group setting. This approach facilitates knowledge retention and development of critical thinking skills.

Theme 1

The first theme of the book discusses the importance of connecting STEM education to practical, real-world experiences. It highlights the need for integrating STEM curriculum with problem-based projects that provide meaningful learning experiences. The book recommends the incorporation of extracurricular activities and culture as foundational to providing practical STEM learning experiences to students.

Theme 2

The second theme explores the changing U.S. demographics and the need for developing STEM literacy among diverse student populations. The book advocates for cultivating passion and dedication among students through the realization of achievable competencies and personal beliefs. It recommends the appreciation of how mathematics is applied in everyday life and the use of visual representation approaches to help students overcome obstacles to problem-solving.

Theme 3

The third theme of the book discusses the importance of organizational leadership in addressing the STEM crisis. It highlights the need for innovative learning methods that align with the 21st-century environment and intertwine STEM with educational and extracurricular activities. The book recommends the transformation of the U.S. educational system from outdated practices to successful 21st-century out-of-the-box methods that make STEM-literacy a foundation of one's knowledge.

This literature review book provides a comprehensive analysis of the STEM education reform literature and advocates for action learning theory as a transformative approach to STEM education. It is a must-read for educators, policymakers, and anyone interested in advancing 21st-century learning through STEM education.

Literature Review

STEM challenges have been found to improve STEM learning by providing students with a connection to real-world problems, intrinsic motivation to learn, and exposure to a healthy STEM culture. According to research, competitions and games can create a sense of purpose to problem-solving and increase positive attitudes toward STEM coursework and careers.

Furthermore, impactful STEM education and outreach efforts can be found outside the classroom through clubs, competitions, and hands-on activities. Exposure to a good STEM mentor can also affect student learning and the desire to pursue a STEM career path.

However, low-income students face challenges in accessing STEM programs due to a scarcity of resources. They have limited access to technology and materials, and many do not have parents who can afford to pay for extra-curricular STEM competitions or activities. The increasing diversity of the U.S. population indicates the need for more diverse STEM programs that address the challenges faced by low-income students. Overall, STEM challenges can provide an effective way to engage students in STEM learning, but more needs to be done to ensure that all students have access to these opportunities regardless of their economic background.

In recent years, the demographic landscape of primary and secondary

schools in the United States has undergone a historic shift. As Bidwell (2015) noted, the 2014-2015 school year marked the first time when the majority of school-aged children were racially diverse. This transformation has significant implications for STEM education, as historically underserved groups, including women, disabled persons, and students from low-income households, now represent a significant portion of the student body.

Roberts (2010) highlighted the lack of access to STEM opportunities for these diverse groups and emphasized the need for STEM education to be made available to all learners. This is particularly important given the growing demand for STEM-literate workers in the United States. Drew (2011) warned that

if current trends continue, the proficiency gap in sciences will widen between the haves and have-nots. To address this issue, decision-makers must take action to support STEM education initiatives. Organizational leadership is critical in this effort, as it is essential to provide students with access to successful STEM opportunities through actionable learning methods that lead to the development of a strong U.S. workforce. The entire U.S. economy revolves around technology development through skilled STEM-literate citizens; therefore, it is the responsibility of U.S. education leaders and relevant stakeholders to inculcate the importance of STEM throughout the U.S. educational continuum and workforce.

Investing in out-of-school STEM activities is one way to support this goal. The National Academies Press (2015) recommended policy makers focus on out-of-school STEM initiatives. Howard-Brown and Martinez (2012) found that out-of-school activities provide many benefits and recommended supporting future investments in out-of-school learning activities for students and out-of-school preparedness opportunities for teachers. The Government Accountability Report (2011) found that STEM education and research programs increase worldwide competitiveness through STEM career preparation benefiting the education field through developing competent future leaders.

However, it is important to recognize that providing a simple subsidy for STEM outreach programs will no longer meet demand signal programs in- and out-of-school. Fully funded programs are needed to reach the low-income population. Access must be viewed as an important link to connecting students and parents with very few resources to open and free impactful experiences. Public parks and libraries provide access to all levels of income to enjoy the outdoors or read books. Public commodities should be considered untapped STEM education resources that can be leveraged to engage the low-income communities.

Overall, the changing demographic landscape of primary and secondary schools in the United States

underscores the need for greater investment in STEM education initiatives that support historically underserved groups. With the right organizational leadership and investment in out-of-school STEM activities, decision-makers can help ensure that all learners have access to the skills and knowledge necessary to thrive in a rapidly changing global economy.

STEM education and outreach are critical components of today's educational landscape, and there is a growing need to provide greater access to STEM activities for all students, regardless of their economic or ethnic backgrounds. This is the message that leading experts in the field, such as Jin and Bierma (2013), have been emphasizing for years.

One of the biggest challenges facing schools today is the difficulty of achieving STEM-literacy outcomes among students, given the increasing class sizes and shrinking budgets that many schools are facing. This is where innovative approaches like the use of clickers in the classroom, as described in the literature, can be highly effective in promoting interactive teaching strategies and improving students' understanding of STEM concepts.
But this is just the tip of the iceberg. To truly address the growing need for STEM education in the US, we need to implement a more comprehensive and inclusive approach to learning that goes beyond the classroom walls. We need to create more opportunities for students to engage in STEM activities outside of

school, whether it's through community outreach programs or through collaborations with local businesses and organizations.

Furthermore, as Drew (2011) has pointed out, we need to address the cultural and statistical biases that exist in many educational tests, such as the Scholastic Achievement Test (SAT), which often unfairly penalize students from minority backgrounds. By removing subconscious barriers and tailoring STEM education to relatable concepts, we can create a lifelong connection to STEM-literacy that benefits all students, regardless of their backgrounds.

At the end of the day, increasing access to STEM activities is not just about improving academic outcomes or ensuring that students are better prepared for higher education. It's about creating a more inclusive and equitable society, where everyone has the opportunity to pursue their passions and realize their full potential. And that is a cause worth championing.

Synthesis Summary

To foster innovation and problem-solving in STEM, extracurricular activities must be accessible and STEM education needs to be a part of everyday life. The negative image of STEM needs to be reshaped through healthy competition and active learning theory. Action learning quickly translates theory into practice, expanding creativity and developing teamwork, self-awareness, and leadership skills. Using action learning in STEM activities can help individuals identify their strengths and roles within a team, ultimately promoting a desire to grow competencies in STEM subjects and take ownership of STEM for the U.S. In the pursuit of developing a STEM-literate citizenry through action learning empowered by leadership, this literature

review identified four key concepts: STEM integration, STEM culture experiences, policy and support, and groups underrepresented in STEM. To achieve long-term progress, it is important to have measurable outcomes and sustainability in initiatives. STEM literacy involves interdisciplinary knowledge, skills, and abilities, and should be visually connected to real-world problems to improve strategic thinking and problem-solving abilities. Areas in need of future research include the development of a centralized tool to access STEM opportunities, measurable learning outcomes for each category of STEM education, further research on groups underrepresented in STEM, and understanding the demographics of specialized STEM schools. Additionally, research should be conducted on how

to engage traditionally difficult-to-reach groups and provide incentives to motivate students during difficult learning stages.

As a renowned author (Malcolm X, influential African American human rights activist, 1925-1965) once wrote, "The future belongs to those who prepare for it today." Thus, through further research in these areas, we can prepare for a future of STEM-literate citizens empowered by leadership and action learning.

Conclusion

As we reach the end of this literature review, STEM education in the 21st century must adapt to the ever-evolving technological landscape of our world. This review has united work in three major theme areas: connecting STEM education to relevant and meaningful experiences, developing STEM-literacy in the changing U.S. demographics, and approaching the STEM crisis through organizational leadership. While past theories of 21st century STEM-literacy were concentrated on curriculum revision, current thinking builds on historical theories to develop an unconventional path forward to STEM education reform. STEM-literate skills are critical for the future workforce of the U.S., providing a foundation of dynamic problem-solvers to meet future

challenges. With innovative solutions, we can solve relevant current and future problems, maintain U.S. global competitiveness, and avoid long-term damage to the world in which all people must share. It is in the vested interest of every U.S. citizen to protect one's freedom and help others around the world. Further research in alternative learning areas can attribute to future in-depth knowledge of reforming STEM in the U.S. We must expand upon a combination of in- and out-of-school learning with respect to the changing U.S. demographics using action learning theory. The U.S. educational system must be reformed to the 21st century environment and intertwine STEM activities with education and extracurricular activities to be globally competitive.

In conclusion, this literature review provides a roadmap for the future of STEM education in the U.S. By connecting STEM education to relevant experiences, developing STEM-literacy, and approaching the STEM crisis through organizational leadership, we can prepare a future workforce of dynamic problem-solvers to meet the challenges of the 21st century. The future of the U.S. depends on our ability to adapt to the technological tools and ways of learning in the 21st century, and to maintain sustainable freedom, national power, and respect among other countries that could become a threat. It is up to us to rise to the challenge and create a brighter future for ourselves and for generations to come.

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