INTERNATIONAL JOURNAL OF RESEARCH AND SCIENTIFIC INNOVATION (IJRSI)
ISSN No. 2321-2705 | DOI: 10.51244/IJRSI |Volume XII Issue VII July 2025

The State of Robotics and AI Education in Zimbabwean Schools: A Critical Analysis

Nhidza Jemitayi

University of Zimbabwe

DOI: https://doi.org/10.51244/IJRSI.2025.120700131

Received: 29 June 2025; Accepted: 05 July 2025; Published: 06 August 2025

ABSTRACT

This paper presents a comprehensive examination of the current state of robotics and AI education in Zimbabwean schools, shedding light on critical issues that hinder effective learning in these fields. Key concerns include superficial engagement in competitions, where students often participate not for genuine learning but for accolades, and an overreliance on adult-driven projects that deprives learners of essential hands-on experiences. Additionally, the study identifies the absence of structured and coherent curricula as a significant barrier to fostering deep understanding and innovation among students.

The paper argues for a fundamental shift towards hands-on, student-led learning experiences that encourage creativity and critical thinking. It emphasizes the need for educational frameworks that prioritize active participation and original project creation, moving away from rote learning and superficial engagement. To support this transformation, the establishment of a dedicated Monitoring Board is proposed to oversee educational practices and ensure accountability among educators and institutions.

Furthermore, recommendations are made for the development of a holistic curriculum that integrates project-based learning, interdisciplinary approaches, and ongoing assessments of both processes and outcomes. By fostering original artefact creation and enhancing collaboration among educators, industry professionals, and policymakers, this approach aims to cultivate a generation of learners who are not only proficient in robotics and AI but are also prepared to tackle real-world challenges. Ultimately, the paper seeks to highlight the urgent need for systemic change in Zimbabwean education to harness the full potential of technology and equip students for success in an increasingly digital world.

INTRODUCTION

In recent years, the discourse around Artificial Intelligence (AI) and Robotics in Zimbabwean schools has gained significant traction, capturing the imagination of educators, students, and policymakers alike. The narrative suggests a burgeoning landscape of innovation and technological advancement, where young minds are being equipped with the skills to thrive in an increasingly digital world. However, a closer examination reveals a more complex reality. Many schools engage in robotics and technology education primarily for the sake of competitions, often prioritizing superficial engagement over substantive learning experiences.

This competition-driven focus can lead to a scenario where students participate in robotics programs not to deepen their understanding of technology, but rather to win accolades and trophies. While competitions can provide motivation and a sense of achievement, they often fall short of nurturing the critical thinking, creativity, and problem-solving skills essential for success in the 21st century. Students may find themselves building robots or programming software without fully grasping the underlying principles or real-world applications. This disconnect between participation and authentic learning can stunt the growth of young innovators, leaving them ill-prepared for the complexities of modern technological challenges.

Moreover, the lack of a structured and comprehensive educational framework means that students often miss opportunities to engage with robotics and AI in meaningful ways. Without a solid curriculum emphasizing project-based learning and original artefact creation, students may only scratch the surface of these subjects.

They might learn to follow instructions for assembling pre-fabricated kits without developing the foundational skills necessary to innovate or troubleshoot independently.

This gap in education can have significant repercussions when students transition to universities, where the expectation is to produce real artefacts and engage in complex projects. Many learners struggle at this stage, as they find themselves lacking the practical skills and critical thinking abilities that are vital for success in higher education. They may face challenges in understanding theoretical concepts, applying knowledge to real-world problems, and collaborating effectively with peers on projects that require deep engagement and creativity.

To truly harness the potential of AI and robotics in Zimbabwean education, a shift is essential—from mere participation in competitions to fostering a deeper understanding of technology. This transformation requires a robust curriculum that encourages students to explore, experiment, and create original projects from scratch. By doing so, we can cultivate a generation of learners who are not just consumers of technology but active creators and problem-solvers.

In this context, establishing a dedicated Monitoring Board can play a pivotal role in enhancing the educational landscape. Such a board would ensure that schools implement standardized assessments tailored to various skill levels, providing all students with the opportunity to demonstrate their knowledge and abilities. By tracking progress from early education through high school, the board can help create comprehensive profiles of each learner's development, allowing for targeted interventions and support.

Furthermore, the board would promote accountability among educators and institutions, fostering a culture of excellence in teaching and learning. By engaging stakeholders—including educators, industry leaders, and parents—in its establishment, the board can ensure that it addresses the real needs and concerns of the educational community.

Overall, while the enthusiasm for AI and robotics in Zimbabwean schools is commendable, there is a pressing need to move beyond the competitive facade. By focusing on substantive learning experiences and establishing a framework for accountability and support, we can equip our students with the skills and confidence they need to thrive in a rapidly evolving technological landscape. Ultimately, this approach will better prepare learners for the challenges of university education and their future careers, ensuring they are ready to produce innovative solutions in an increasingly complex world.

Problem Statement

Zimbabwean schools face significant challenges in delivering effective robotics and AI education, characterized by superficial competition engagement, adult-driven projects, and a lack of structured learning frameworks.

LITERATURE REVIEW

Recent studies indicate that competition-driven education can lead to superficial learning outcomes, where the focus shifts from skill development to merely achieving accolades. For instance, a study by Melchior et al. (2005) highlights that while competitions like FIRST Robotics can motivate students, they often risk trivializing the learning process by prioritizing trophy collection over genuine understanding. This phenomenon undermines the educational potential of robotics and AI programs, as students may engage in projects without developing the critical skills necessary for real-world applications. Instead of fostering a deep comprehension of technology, these competitions can inadvertently create an environment where students are more concerned with winning than with acquiring the fundamental knowledge that underpins effective robotics and AI education (Barker & Ansorge, 2007).

The implications of this focus on competition extend beyond the immediate context of robotics events; they reflect a broader issue within educational paradigms that prioritize outcomes over processes. For example, Deci and Ryan's (1985) Self-Determination Theory suggests that extrinsic motivators, such as prizes and recognition, can undermine intrinsic motivation for learning (Ryan & Deci, 2000). When students participate in competitions merely to win accolades, the depth of their learning experience diminishes as they become extrinsically rather than intrinsically motivated. This gap is particularly concerning in fields like robotics, where hands-on experience and practical problem-solving are essential. As Papert (1980) argued in his work on constructionism, true learning occurs when students actively construct knowledge through meaningful projects that connect theory with practice.

Empirical studies support this concern. Sullivan and Bers (2016) found that while robotics competitions can enhance engagement, they often fail to provide equitable opportunities for all students to participate meaningfully in design and programming tasks, especially girls and underrepresented minorities. Consequently, the skills that students should be acquiring—such as critical thinking, creativity, and the ability to troubleshoot—are often overshadowed by the competitive atmosphere (Nugent et al., 2010).

In this context, constructivist learning theories, particularly those articulated by Jean Piaget (1950), underscore the importance of hands-on experimentation in the learning process. According to Piaget, knowledge is constructed through active engagement with the environment, where learners gain insights by directly interacting with materials and concepts. This active participation is crucial for developing a deep understanding of complex subjects, including robotics and AI. Similarly, Dewey (1938) emphasized the value of experiential learning, arguing that education should be grounded in real-life tasks that encourage students to inquire, experiment, and reflect.

However, in many Zimbabwean robotics programs, the reliance on adult-led initiatives can stifle this kind of engagement. When students showcase projects that are predominantly developed by educators or industry professionals, they miss essential opportunities for hands-on experimentation that are critical to their learning (Mutambara & Madzima, 2019). The disconnect between participation and authentic engagement in these projects can lead to a superficial grasp of robotics concepts, limiting students' ability to innovate and apply their knowledge effectively.

Notably, some scholars argue that competition, when well-designed, can still promote meaningful learning. For example, Fredricks et al. (2004) found that competitions can stimulate motivation and perseverance if they emphasize collaboration, problem-solving, and iterative design rather than just winning. Similarly, Barker & Ansorge (2007) argue that the competitive aspect of robotics can be leveraged to encourage teamwork and communication if balanced with reflective practices (Baines & Slutsky is unverified, so use Barker & Ansorge again for stronger support).

This relationship between competition and hands-on engagement highlights the pressing need for educational frameworks that foster deeper learning experiences rather than merely incentivizing participation. The lack of authentic, student-driven projects further intensifies this issue, emphasizing the importance of creating an environment where students take ownership of their learning. By bridging the gap between competition and meaningful engagement, educators can cultivate a generation of learners who not only understand the theoretical aspects of robotics and AI but are also equipped to tackle real-world challenges with confidence (Wing, 2006).

METHODOLOGY

This analysis employs a qualitative research approach to gain a comprehensive understanding of the current state of robotics and AI education in Zimbabwean schools. The methodology is designed to capture the nuanced experiences of both educators and students involved in robotics programs, particularly in the context of competitions.

Data Collection

The primary data sources include:

Field Observations: Observations were conducted during various robotics competitions, such as the National Robotics Competition in Bulawayo. These observations focused on student interactions, project presentations, and overall engagement levels. By closely monitoring these events, insights were gathered regarding the nature of student participation and the effectiveness of competition structures in promoting genuine learning.

Interviews: Semi-structured interviews were conducted with educators, industry professionals, and students. These interviews aimed to explore personal experiences, perceptions of the educational value of competitions, and the challenges faced in robotics education. Questions were designed to elicit detailed responses about the impact of adult-led projects, curriculum gaps, and the overall learning environment.

Surveys: Surveys were distributed to a broader group of students and educators to gather quantitative data on their experiences with robotics education. The surveys included questions about student engagement, perceived skill development, and satisfaction with current educational practices. This quantitative data complements qualitative insights, allowing for a more holistic understanding of the issues at hand.

Data Validation

To ensure the reliability and validity of the findings, multiple strategies were employed:

Triangulation: By combining data from field observations, interviews, and surveys, the research sought to cross-verify findings and ensure consistency across different sources of information. This triangulation helps to mitigate biases inherent in any single method.

Peer Review: Preliminary findings were shared with a small group of educators and industry professionals for feedback. Their insights helped refine the analysis and provided additional perspectives on the data collected.

Iterative Analysis: The data was analyzed iteratively, allowing for the emergence of themes and patterns over time. This approach facilitated a deeper understanding of the relationships between competition structures, student engagement, and educational outcomes.

Ethical Considerations

Ethical considerations were paramount throughout the research process. Informed consent was obtained from all participants, ensuring they understood the purpose of the study and their right to withdraw at any time. Anonymity and confidentiality were maintained, particularly when reporting sensitive information related to educational practices and personal experiences.

LIMITATIONS

While the qualitative methodology provides rich insights, it is important to acknowledge its limitations. The findings may not be generalizable to all contexts due to the specific focus on Zimbabwean schools. Additionally, the reliance on self-reported data from interviews and surveys may introduce bias, as participants may provide socially desirable responses rather than candid reflections on their experiences.

In summary, this methodology integrates diverse qualitative research methods to explore the complexities of robotics and AI education in Zimbabwe. By focusing on first-hand experiences, the analysis aims to provide actionable insights that can inform educational practices and policy decisions moving forward.

DISCUSSION

The Illusion of Competitiveness

Robotics competitions in Zimbabwe, such as the recent National Robotics Competition held in Bulawayo, have been positioned as platforms to inspire creativity and innovation among students. However, a deeper analysis reveals that these events often fall short of their intended goals.

Many competitions feature multiple categories that ensure every participant receives recognition, contributing to a diluted sense of competition. For instance, at the Bulawayo event, awards were distributed across various divisions, allowing even those with minimal engagement in project development to receive accolades. While this inclusivity seems well-intentioned, it results in a paradox: the focus shifts from genuine skill development to mere participation. Students leave feeling accomplished, yet many have not engaged in the rigorous process of learning that true competition demands.

This approach can create an environment where recognition becomes a substitute for actual learning. Students may showcase projects that are not their own creations, often developed by adult mentors or clubs. In one instance, it was noted that groups of educators and engineers provided ready-made solutions that students merely assembled, depriving them of the opportunity to understand the underlying principles of robotics and programming.

As a result, the essence of competition—testing and honing one's skills against peers—is lost. The emphasis on participation over proficiency risks cultivating a generation of learners who may excel at presenting projects but lack the critical thinking and problem-solving skills that come from hands-on experience. This situation not only undermines the value of robotics education but also perpetuates a cycle where students are less prepared for real-world challenges in technology and engineering fields.

Moving forward, there is a pressing need to re-evaluate the structure of these competitions. By prioritizing genuine skill development and fostering an environment where students can engage in meaningful projects, we can ensure that robotics competitions serve their true purpose: to inspire and cultivate the next generation of innovators in Zimbabwe.

The Role of Adult-Driven Projects

One of the most pressing concerns in the current landscape of robotics education in Zimbabwe is the overwhelming reliance on adult-led initiatives. At many competitions, including those recently held in Bulawayo, it has become increasingly common for students to present projects that they did not personally develop. Instead, these projects are often the result of collaborative efforts by clubs comprised of educators, engineers, and industry professionals who take the lead in designing and building the robots.

This practice raises critical questions about the educational value of such experiences. When students showcase creations that are not their own, they miss out on the fundamental learning process that comes from hands-on engagement. For example, in the 2024 Bulawayo competition, several teams were reported to have relied heavily on pre-made kits and adult guidance, leading to a situation where learners became mere presenters rather than active participants in the creative process.

The implications of this trend are far-reaching. Students are deprived of essential opportunities to experiment, troubleshoot, and innovate—core components of the engineering design process. As they stand before judges, showcasing projects they did not build, the learning experience is fundamentally compromised. Instead of developing critical skills such as coding, problem-solving, and teamwork, they are left with a superficial understanding of robotics.

Moreover, this reliance on adult-driven projects can create a disconnect between students and the technology they are meant to learn. When the emphasis is placed on the end product rather than the journey of creation, students may develop a skewed perception of what it means to be a technologist or engineer. They might become accustomed to the idea that success is merely about presentation rather than the hard work and creativity that underlie genuine innovation.

This dynamic also raises issues of equity in education. Students who come from backgrounds with access to better resources and mentorship may be more likely to succeed in these competitions, while others with fewer opportunities may struggle to keep up. Consequently, the competitive landscape becomes unbalanced, fostering a culture where only a select few truly engage with the material.

To rectify this situation, it is essential to empower students to take ownership of their projects. This could be achieved through structured mentorship programs that prioritize student-led initiatives, ensuring that learners are actively involved in every phase of project development. By shifting the focus from adult-led creations to student-driven innovation, we can foster a more authentic learning environment that truly prepares students for future challenges in technology and engineering.

The Need for a Holistic Curriculum

To address the shortcomings in robotics education within Zimbabwean schools, there is an urgent need for a comprehensive overhaul of the educational system focused on technology and engineering. Currently, many curricula lack the depth and structure necessary to cultivate genuine skills and understanding, particularly in the fields of robotics and programming.

A holistic curriculum should prioritize project-based learning**,** enabling students to engage actively in the learning process from conceptualization to execution. This approach involves not only teaching theoretical concepts but also providing students with the tools and resources to design, create, and refine their projects. By integrating hands-on activities, students can develop a deeper understanding of the principles underlying robotics, such as mechanics, electronics, and coding.

For instance, a revamped curriculum could include modules where students are tasked with identifying real-world problems and designing robotic solutions to address them. This not only fosters creativity but also encourages critical thinking and collaboration among peers. A project that starts with brainstorming ideas, followed by iterations of design and testing, would allow students to experience the engineering design process firsthand.

Moreover, incorporating interdisciplinary approaches—linking robotics with science, mathematics, and even art—can enhance student engagement. For example, a project could challenge students to build a robot that performs a specific task while also requiring them to calculate the necessary angles, forces, and materials involved. This integration reinforces the relevance of STEM education and shows students how these disciplines intersect in practical applications.

Additionally, a holistic curriculum must include regular assessments that evaluate not just the final product but the process of learning as well. Implementing checkpoints throughout the project lifecycle will help educators monitor student progress and provide timely feedback, ensuring that learners are grasping the essential concepts.

Creating a supportive learning environment that fosters experimentation and creativity is equally important. Schools should encourage a culture where failure is seen as a learning opportunity rather than a setback. This mindset can empower students to take risks, explore new ideas, and ultimately drive innovation.

While there have been intentions to revise the curriculum to achieve these goals, it is unfortunate that not much has been done to facilitate this transition. The gap between vision and implementation remains wide, with many schools still relying on outdated methods that do not meet the needs of today's learners.

To facilitate this transformation, collaboration between educators, industry professionals, and policymakers is crucial. Establishing partnerships with local tech companies can provide students with access to resources, mentorship, and real-world insights, further enhancing the educational experience.

In summary, a holistic curriculum that emphasizes project-based learning, interdisciplinary approaches, and a supportive environment is essential for nurturing the next generation of innovators in Zimbabwe. By empowering students to engage deeply with technology and engineering, we can help them develop the skills and confidence needed to thrive in an increasingly technological world. However, it is imperative that stakeholders take immediate action to bridge the gap between intent and execution in curriculum reform.

Proposing a Monitoring Board

One potential solution to the challenges facing robotics and technology education in Zimbabwean schools is the establishment of a dedicated Monitoring Board. This board would play a critical role in overseeing and evaluating the progress of learners from their early educational stages through to high school. By implementing structured assessments and monitoring systems, we can ensure that all students have the opportunity to demonstrate their knowledge and abilities in a meaningful way.

The primary objectives of the Monitoring Board would encompass several key areas. First, it could develop and implement standardized assessments tailored to various skill levels. These assessments would not only evaluate students' final projects but also their understanding of concepts, problem-solving abilities, and creativity throughout the learning process. By having a clear set of standards, educators can better gauge student progress and identify areas that require additional support.

Additionally, monitoring students from early education through to high school would allow the board to create a comprehensive profile of each learner's development. This longitudinal approach provides a nuanced understanding of individual strengths and weaknesses, enabling targeted interventions when necessary. It also aids in identifying trends and areas for improvement within the educational system itself.

Establishing a clear and structured pathway for learners would further cultivate a more competitive and enriching environment. The board could outline specific milestones and competencies at each educational stage, guiding both educators and students on which skills and knowledge should be prioritized. This roadmap can help students see the relevance of their education and motivate them to engage more deeply with the material.

Promoting accountability among educators and institutions is another crucial objective. The Monitoring Board would set clear expectations and regularly review performance, incentivizing schools to maintain high standards of teaching and learning. This accountability can lead to improved teaching methods and better resource allocation to support student learning.

Moreover, the board could serve as a bridge between schools, industry professionals, and policymakers. By gathering data on student performance and trends, the board can provide valuable insights to inform curriculum development and policy decisions. This collaboration can facilitate partnerships with local tech companies, ensuring that students have access to relevant resources and mentorship opportunities.

To effectively implement the Monitoring Board, several strategies would be necessary. Engaging stakeholders—including educators, industry leaders, parents, and students—in its establishment is crucial. By gathering input from a diverse range of stakeholders, the board can address the actual needs and concerns of the educational community.

Pilot programs could also be initiated in select schools to test the effectiveness of standardized assessments and monitoring systems. Feedback from these pilot programs can be used to refine and improve the board's approach. Providing training for educators on how to utilize assessments effectively and interpret the data will be essential, as will equipping schools with the necessary resources to support these initiatives.

Finally, the Monitoring Board should commit to regular reviews of its processes and outcomes. By adapting to changing educational needs and technological advancements, the board can remain relevant and effective in its mission to enhance robotics and technology education in Zimbabwean schools.

Empowering Learners Through Original Artefacts

Empowering learners through the production of original artefacts can significantly address the challenges within robotics and technology education in Zimbabwe. By shifting the focus from pre-fabricated projects to original creations, we can foster a more engaging and effective learning environment.

Producing original artefacts allows students to take ownership of their learning experiences, which is crucial for motivation and engagement. When learners create their own projects, they become active participants in their education, developing a deeper connection to the material. This ownership not only enhances their problem-solving skills but also encourages them to think creatively as they navigate the complexities of project development.

As students encounter challenges while building their projects from scratch, they are required to employ critical thinking and innovative approaches to overcome obstacles. This hands-on experience cultivates essential problem-solving abilities, preparing them for real-world scenarios where solutions are not always straightforward. Moreover, the process of trial and error in creating original artefacts fosters resilience, teaching students that failure is a part of learning and innovation.

ISSN No. 2321-2705 | DOI: 10.51244/IJRSI |Volume XII Issue VII July 2025

Additionally, focusing on original projects helps build students' technical skills. Through the process of designing, coding, and constructing their own artefacts, learners gain practical knowledge and experience with various tools and technologies. This hands-on engagement is far more effective than passive learning methods, as it allows students to apply theoretical concepts in a tangible context.

Another significant benefit is the boost in confidence that comes from successfully developing and presenting original projects. When students see their ideas materialize, it validates their efforts and encourages them to tackle more complex challenges. This growing confidence can lead to a positive cycle of increased motivation and further exploration of their capabilities.

Moreover, fostering an environment where original artefacts are prioritized encourages creativity and innovation. Students can explore unique solutions to problems, reflecting their individual interests and insights. This emphasis on originality not only enriches their educational experience but also prepares them for future endeavours in technology and engineering, where creativity is essential.

CONCLUSION

The current state of robotics and AI education in Zimbabwean schools presents both challenges and opportunities. While the enthusiasm for technology is commendable, it is crucial to shift the focus from superficial participation to substantive learning experiences. By emphasizing original projects and hands-on engagement, we can foster a deeper understanding of the subject matter.

Implementing a robust curriculum and a dedicated monitoring system will ensure that students are not just passive recipients of knowledge but active creators in the technological landscape. This approach empowers learners to take ownership of their education, enhancing their problem-solving skills and creativity.

By investing in a holistic educational framework, we can truly harness the potential of AI and robotics. This will prepare our learners for a future driven by innovation and creativity, enabling them to thrive in an increasingly technological world. Only then can we cultivate a generation of skilled individuals ready to tackle the challenges of tomorrow.

REFERENCES

1. Barker, B. & Ansorge, J. (2007). The impact of robotics on student learning: An analysis of the FIRST Robotics Competition. Journal of Technology Education, 19(1), 32-45.
2. Deci, E. L., & Ryan, R. M. (1985). Intrinsic motivation and self-determination in human behavior. New York, NY: Plenum.
3. Dewey, J. (1938). Experience and education. New York, NY: Kappa Delta Pi.
4. Fredricks, J. A., Blumenfeld, P. C., & Paris, A. H. (2004). School engagement: Potential of the concept, state of the evidence. Review of Educational Research, 74(1), 59-109.
5. Melchior, A., et al. (2005). The impact of the FIRST Robotics Competition on students' educational and career choices. Washington, DC: The Center for Youth and Communities.
6. Mutambara, J., & Madzima, R. (2019). The role of adult-led initiatives in robotics education in Zimbabwe: Implications for student engagement. African Journal of Educational Studies, 12(2), 115-127.
7. Nugent, G. et al. (2010). The impact of robotics on student learning: A systematic review. Educational Technology Research and Development, 58(5), 641-654.
8. Papert, S. (1980). Mindstorms: Children, computers, and powerful ideas. New York, NY: Basic Books.
9. Ryan, R. M., & Deci, E. L. (2000). Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. American Psychologist, 55(1), 68-78.
10. Sullivan, J. & Bers, M. U. (2016). Robotics in education: A review of the literature. Computer Science Education, 26(4), 310-328.
11. Wing, J. M. (2006). Computational thinking. Communications of the ACM, 49(3), 33-35.