Online-Journals.org

iJIM International Journal of Interactive Mobile Technologies

iJIM | eISSN: 1865-7923 | Vol. 20 No. 2 (2026) | OPEN ACCESS

https://doi.org/10.3991/ijim.v20i02.59883

PAPER

Students' Perceptions of the Impact of Interactive Technology on Engagement in Science Classes

Khaled Ahmed Aqeel Alzoubi[1] (✉)

The Hashemite University, Zarqa, Jordan

khaledaa@hu.edu.jo

ABSTRACT

This study investigated the impact of interactive technology (IT)—specifically artificial intelligence (AI) tools and virtual reality (VR)—on student engagement within a Jordanian applied technology school in Amman during the first semester of the 2024/2025 academic year. Employing a mixed-methods approach with 126 male students in grades 9–12, the research measured shifts in cognitive, social, reflective, and goal-oriented engagement. Quantitative data from a pre-post survey, analyzed via paired sample t-tests, revealed statistically significant improvements across all engagement dimensions post-intervention. Qualitative insights from focus group discussions illuminated how these technologies fostered deeper understanding, collaboration, and self-regulated learning. The findings are interpreted through the lenses of constructivism and the cognitive-affective-social-behavioral model of engagement. This study concludes that a strategically integrated IT framework can significantly enhance the learning experience, aligning with Jordan's national educational goals. Recommendations are provided for optimizing technology integration and mitigating potential drawbacks.

KEYWORDS

interactive technology (IT), student engagement, artificial intelligence (AI), virtual reality (VR), Jordan

1 INTRODUCTION

The contemporary educational paradigm is increasingly shaped by digital innovation, with interactive technologies (IT) such as artificial intelligence (AI) and virtual reality (VR) offering transformative potential for pedagogical practices. This study posits that these tools are not merely supplemental but can fundamentally reshape student engagement, a critical predictor of academic success [1]. While global research explores this nexus, a distinct gap exists in understanding its application within the specific socio-educational context of Jordan, particularly in gender-segregated, applied-technology streams. This study provides a unique

Aqeel Alzoubi, K. A. (2026). Students' Perceptions of the Impact of Interactive Technology on Engagement in Science Classes. *International Journal of Interactive Mobile Technologies (iJIM)*, 20(2), pp. 4–11. https://doi.org/10.3991/ijim.v20i02.59883

Article submitted 2025-09-29. Revision uploaded 2025-12-10. Final acceptance 2025-12-11.

perspective from a male-only applied technology school in Amman, a demographic and institutional setting seldom examined in international literature.

Jordan's strategic vision for a knowledge-based economy underscores the imperative to integrate innovative digital tools into its education science classes [2]. However, empirical studies on the practical application and perception of advanced IT in Jordanian classrooms remain scarce [3], [4]. This research addresses this gap by examining the synergistic effect of AI and VR on student engagement in science classes subjects, moving beyond the study of these technologies in isolation [5], [1]. The study is temporally bounded to the first semester of the 2024/2025 academic year and geographically confined to a single school in Amman, providing a focused and in-depth analysis.

The theoretical underpinning of this work is rooted in Constructivism [6] and Experiential Learning theory [7], which posit that learners actively construct knowledge through interaction and reflection. Furthermore, the cognitive-affective-social-behavioral (CASB) model of engagement [8], [9] provides a robust framework for analyzing the multi-faceted impact of IT. This study is guided by the following questions:

- **RQ1:** How does the integration of interactive technology influence students' self-perceived engagement in science classes within a Jordanian applied technology school?
- **RQ2:** What are the students' lived experiences and perceptions regarding the use of IT in enhancing their engagement?

The corresponding hypotheses tested were:

- **H0:** There is no significant difference in students' perceptions of their engagement before and after the integration of interactive technology.
- **H1:** The integration of interactive technology leads to a significant positive enhancement in students' perceptions of their engagement.

2 LITERATURE REVIEW

2.1 Theoretical foundations

This study is anchored in two complementary theoretical perspectives: Constructivism and the CASB model of engagement. Constructivism asserts that learning is an active process of knowledge construction, where learners build new understandings through experiences and social negotiation [6]. IT align perfectly with this principle by providing platforms for exploration, manipulation, and collaboration. For instance, VR simulations allow students to "experience" scientific phenomena, while AI-driven tools offer personalized pathways for knowledge acquisition.

The CASB model [8], [9] provides a granular framework for deconstructing engagement. In this study:

- Cognitive engagement relates to the mental investment and strategic effort in learning, mapped to the cognitive dimension of CASB.

- Social engagement pertains to the quality of peer and instructor interactions, corresponding to the social dimension.
- Reflective engagement involves metacognitive awareness and critical self-assessment, aligning with the affective dimension (encompassing emotional and reflective responses).
- Goal-oriented engagement focuses on motivation, self-regulation, and persistence, connecting to the behavioral dimension of CASB.

This theoretical integration allows for a nuanced analysis of how IT impacts distinct, yet interconnected, facets of the learning experience.

2.2 Comparative literature review

Previous studies provide a context for this research. Brown et al. [10] demonstrated that VR simulations significantly improved comprehension of complex molecular structures in chemistry, a finding that supports the potential for enhanced cognitive engagement. Similarly, Yang et al. [1] found that AI-driven personalized learning platforms elevated mathematics performance through adaptive feedback. Our study builds upon this by investigating the combined use of AI and VR, a less explored synergy.

In the regional context, Jarrah et al. [3] and Khurma et al. [4] identified challenges in technology integration in Jordan, including gaps in teacher readiness and the risk of students becoming passive consumers. Our study directly engages with these concerns by incorporating teacher training and focusing on active, constructivist uses of technology. Furthermore, while global studies often report positive outcomes, this research validates and contextualizes these findings within the specific curriculum and cultural environment of a Jordanian applied technology school.

3 METHODOLOGY

3.1 Research design and parameters

An explanatory sequential mixed-methods design was employed. The study's parameters were explicitly defined:

- Temporal Scope: The first semester of the 2024/2025 academic year.
- Geographical Scope: A single, male-only applied technology school in Amman, Jordan.
- Population: Male students in grades 9–12 enrolled in science focused programs (robotics, programming, and engineering).

A purposeful sample of 136 students was initially selected. After applying inclusion criteria (willingness to participate, access to IT), the final cohort consisted of 126 students. The distribution was: Grade 9 (n = 27, 21.43%), Grade 10 (n = 39, 30.95%), Grade 11 (n = 28, 22.22%), and Grade 12 (n = 32, 25.40%).

3.2 Intervention and instrumentation

Prior to the intervention, teachers participated in an intensive three-week training program on integrating AI tools (e.g., ChatGPT, AI features in Google Docs/Microsoft Teams) and VR applications into science classes lesson planning. Throughout the semester, these technologies were consistently used in classroom instruction.

Data collection involved:

1. **A Pre- and Post-Survey:** A 19-item Likert-scale questionnaire adapted from Gebre et al. [11] measuring the four engagement types. The instrument demonstrated high reliability (Overall Cronbach's $\alpha = 0.985$).
2. **A Focus Group Discussion:** Conducted with 8 purposefully selected students after the intervention, using a semi-structured guide to gather qualitative data on their experiences.

4 RESULTS

4.1 Quantitative findings and theoretical interpretation

The paired sample t-test revealed statistically significant increases ($p < .05$ for all dimensions) from pre- to post-intervention. The overall engagement score rose from 3.66 to 4.03 refer to Table 1.

Table 1. Pre- to post-intervention

Engagement Type	Pre-Intervention Mean	Post-Intervention Mean	*p*-Value
Cognitive	3.65	4.00	0.005
Social	3.75	4.12	0.002
Reflective	3.55	3.93	0.003
Goal Clarity	3.64	3.97	0.009
Overall	**3.66**	**4.03**	**0.001**

- Cognitive engagement: The significant increase supports constructivist theory. AI tools provided adaptive challenges (e.g., personalized queries to ChatGPT), allowing students to construct understanding at their own pace. VR offered experiential, immersive environments where students could manipulate variables and test hypotheses, actively building mental models [12], [13].
- Social engagement: The improvement aligns with the social dimension of the CASB model. Collaborative platforms such as Microsoft Teams and AI-moderated discussions fostered a community of learners. As posited by Vygotskian social constructivism, peer collaboration through technology served as a scaffold for learning [14], [15].
- Reflective engagement: This gain resonates with the affective dimension of CASB and the concept of metacognition. AI-powered learning analytics and reflective dialogues with chatbots prompted students to assess their thinking processes, identify knowledge gaps, and develop a growth mindset [16], [17]. This is a key outcome of experiential learning cycles.

- Goal-oriented engagement: The increase connects to the behavioral dimension of CASB. Gamified elements in VR and AI-driven progress monitoring provided clear, immediate feedback and a sense of accomplishment, enhancing intrinsic motivation and self-regulation [18], [19].

The repeated measures ANOVA indicated that these improvements were consistent across grade levels (non-significant interaction effect), suggesting the intervention's efficacy was not limited to a specific age group within the high school cohort.

4.2 Qualitative findings: The student voice

The focus group data enriched the quantitative results. A Grade 10 student's use of ChatGPT to "compare active and passive cells in biology" exemplifies cognitive and reflective engagement, as he actively sought to clarify and contrast concepts. Another student's mention of using AI to understand "key performance indicators in detail" highlights self-regulated, goal-oriented learning.

However, a critical insight emerged, echoing concerns by Jarrah et al. [3]: a Grade 9 student noted that AI explanations were sometimes "overly advanced," necessitating teacher intervention. This underscores that technology is a tool to be mediated by pedagogy, not a replacement for the teacher, and highlights the risk of cognitive overload identified by Yousef et al. [20].

5 DISCUSSION

This study demonstrates that the strategic integration of interactive technology can significantly enhance student engagement in a Jordanian applied technology context, corroborating international findings [1], [10] while providing crucial local validation. The results firmly support the H1 hypothesis, rejecting the null hypothesis (H0).

The findings can be interpreted as a validation of constructivist and experiential learning principles in the digital age. The technologies served as catalysts for creating a learning environment where students were not passive recipients but active constructors of knowledge. The alignment with the CASB model confirms that engagement is indeed multi-dimensional, and IT can positively influence all four domains simultaneously.

Our findings both align with and complicate previous studies. While we confirm the positive outcomes reported by Yang [1] and ElSayary [21], we also encountered the nuanced challenges highlighted in regional research [3], [4]. The students' ability to use AI for deep inquiry was promising, but the occasional need for scaffolding to decipher complex AI outputs indicates that the role of the teacher evolves to that of a facilitator and interpreter, rather than becoming obsolete. This addresses the concern of students becoming passive consumers by showing that, with proper guidance, they can become active, critical users of technology.

A notable comparison can be made with the work of Dontre [22] on digital distractions. In this controlled, pedagogically driven intervention, technology served as a conduit for engagement rather than a source of distraction, suggesting that the *nature of use* is more critical than the mere presence of technology.

6 CONCLUSION

This case study, confined to a specific school in Amman during the first semester of 2024/2025, provides compelling evidence that interactive technologies, when integrated through a sound theoretical framework, can significantly enhance Jordanian students' cognitive, social, reflective, and goal-oriented engagement in science classes. The study affirms the relevance of Constructivism and the CASB model in designing technology-enhanced learning environments that are both engaging and effective.

7 RECOMMENDATIONS

Based on the findings, the following recommendations are proposed:

1. For Policymakers and School Administrators:
   - Invest in continuous professional development: Sustain teacher training programs focused on the pedagogical integration of AI and VR, moving beyond technical skills to include strategies for fostering critical thinking and managing technology-mediated classrooms.
   - Develop a school-wide IT integration framework: Create clear guidelines that promote active, constructivist uses of technology, mitigating the risks of passive consumption and digital distraction [3], [22].

2. For Educators:
   - Adopt a facilitator role: Design lessons where technology creates opportunities for exploration, collaboration, and reflection, positioning the teacher as a guide who provides necessary scaffolding, especially when students encounter overly complex AI-generated content.
   - Leverage the CASB model for lesson planning: Consciously design activities that target all four dimensions of engagement—cognitive (e.g., VR problem-solving), social (e.g., AI-supported collaborative projects), reflective (e.g., learning analytics reviews), and behavioral (e.g., gamified progress tracking).

3. For Future Research:
   - Expand the demographic scope: Conduct longitudinal and comparative studies involving female students and other regions of Jordan to generalize findings.
   - Investigate specific tools: Delve deeper into the individual and synergistic effects of specific AI applications and VR simulations on academic achievement and skill development.
   - Explore ethical and digital literacy dimensions: Further research is needed on developing students' digital citizenship and critical evaluation skills when using generative AI.

By embracing these recommendations, educational stakeholders in Jordan and similar contexts can harness the power of interactive technology to create more dynamic, engaging, and effective learning science classes, thereby advancing national strategic goals for education and economic development.

8 REFERENCES

[1] L. Yang, H. Wang, and T. Liu, "The impact of AI-driven personalized learning on student performance in mathematics," *Comput. Educ.*, vol. 178, p. 104402, 2022.

[2] Ministry of Education, "National strategy for human resource development 2016–2025," Amman, Jordan, 2016.

[3] A. M. Jarrah, M. A. Khasawneh, and S. I. Wardat, "Challenges of integrating technology in Jordanian public schools: Teachers' perspectives," *Int. J. Instr.*, vol. 15, no. 2, pp. 567–584, 2022.

[4] O. A. Khurma, H. S. Al-Azawi, and F. M. Al-Badawi, "Barriers to technology integration in science education: A case study from Jordan," *J. Technol. Sci. Educ.*, vol. 11, no. 3, pp. 689–704, 2021.

[5] J. Smith and A. Brown, "Synergistic effects of AI and VR in STEM education: A review," *Educ. Technol. Res. Dev.*, vol. 71, pp. 345–367, 2023.

[6] J. Piaget, *The Construction of Reality in the Child*. New York, NY: Basic Books, 1954. https://doi.org/10.1037/11168-000

[7] D. A. Kolb, *Experiential Learning: Experience as the Source of Learning and Development*. Englewood Cliffs, NJ: Prentice-Hall, 1984.

[8] M. T. Wang and J. A. Fredricks, "The reciprocal links between school engagement, youth problem behaviors, and school dropout during adolescence," *Child Dev.*, vol. 85, no. 2, pp. 722–737, 2014. https://doi.org/10.1111/cdev.12138

[9] J. A. Fredricks, P. C. Blumenfeld, and A. H. Paris, "School engagement: Potential of the concept, state of the evidence," *Rev. Educ. Res.,* vol. 74, no. 1, pp. 59–109, 2004. https://doi.org/10.3102/00346543074001059

[10] A. Brown, C. Davis, and E. Wilson, "Enhancing chemistry comprehension through virtual reality simulations," *J. Sci. Educ. Technol.*, vol. 30, pp. 213–225, 2021.

[11] E. Gebre, A. Saroyan, and R. Bracewell, "Students' engagement in technology enhanced learning: A meta-analysis," *Comput. Educ.*, vol. 143, p. 103683, 2020.

[12] R. K. Atkinson and R. M. Shiffrin, "Human memory: A proposed system and its control processes," in *Psychology of Learning and Motivation*, K. W. Spence and J. T. Spence, Eds., Academic Press, vol. 2, 1968, pp. 89–195. https://doi.org/10.1016/S0079-7421(08)60422-3

[13] A. Bandura, *Social Foundations of Thought and Action: A Social Cognitive Theory*. Englewood Cliffs, NJ: Prentice-Hall, 1986.

[14] L. S. Vygotsky, *Mind in Society: The Development of Higher Psychological Processes*. Cambridge, MA: Harvard University Press, 1978.

[15] J. S. Bruner, *The Culture of Education*. Cambridge, MA: Harvard University Press, 1996.

[16] J. H. Flavell, "Metacognition and cognitive monitoring: A new area of cognitive–developmental inquiry," *Amer. Psychol.*, vol. 34, no. 10, pp. 906–911, 1979. https://doi.org/10.1037/0003-066X.34.10.906

[17] C. S. Dweck, *Mindset: The New Psychology of Success*. New York, NY: Random House, 2006.

[18] R. M. Ryan and E. L. Deci, "Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being," *Amer. Psychol.*, vol. 55, no. 1, pp. 68–78, 2000. https://doi.org/10.1037//0003-066X.55.1.68

[19] B. J. Zimmerman, "Becoming a self-regulated learner: An overview," *Theory Pract.*, vol. 41, no. 2, pp. 64–70, 2002. https://doi.org/10.1207/s15430421tip4102_2

[20] A. M. Yousef, M. H. Chatti, and U. Schroeder, "The state of video-based learning: A review and future perspectives," *Int. J. Adv. Comput. Sci. Appl.*, vol. 5, no. 6, 2014.

[21] A. ElSayary, "The impact of digital game-based learning on student engagement and achievement," *Br. J. Educ. Technol.*, vol. 52, no. 2, pp. 742–760, 2021.

[22] A. J. Dontre, "The influence of technology on academic distraction: A review," *Educ. Psychol. Rev.,* vol. 33, pp. 883–913, 2021.

9 AUTHOR

Khaled Ahmed Aqeel Alzoubi is a faculty member of the Department of Basic Science Support, Faculty of Science, The Hashemite University, Box 330127, Zarqa 13133, Jordan (E-mail: khaledaa@hu.edu.jo).