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Original Paper

Integrating Cultural-Historical Activity Theory and Authentic Learning with Technology in Teaching and Learning: A Case Study Analysis

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Abstract

This research work presents a comprehensive framework that merges Cultural-Historical Activity Theory (C), Authentic Learning (A), and six distinct roles of Technology (T) in the context of teaching and learning. The study reviews five individual case studies that explore the utilization of technology in educational settings, examining their alignment with the CAT framework. The research highlights the significance of adventure games as an effective medium for knowledge construction, wherein embedded puzzles and core content serve as extrinsic mediators, while discussions between players intrinsically mediate knowledge construction. Additionally, artifacts of mass media, such as games, software, and other media, facilitate knowledge production when they function as tools rather than objects of the activity. Drawing on Vygotskian concepts of social tool-mediated dialogical knowledge construction, the research concludes that games and media play an integral role in enhancing teaching and learning experiences. This study aims to contribute to the broader understanding of technology integration in education, encouraging educators to adopt transformative approaches to optimize the benefits of technology in the learning process.

Keywords

Technology, Teaching and Learning, Adventure Games, Cultural-Historical Activity Theory, Authentic Learning

1. Introduction

The primary aim of this study is to explore and discuss the application of a theoretical framework that supports the integration of technology and contemporary media in educational settings. In both residential and distance education systems, Learning Management Systems (LMS) are widely employed. However, the design of LMS may partly hinder innovative, collaborative, and interactive learning experiences (Reeves, Herrington & Oliver, 2004).

Several LMS designs tend to prioritize content (Finger & Jamieson-Proctor, 2009), focus on technical aspects (Dutton, Cheong, & Park, 2004), utilize commodified learning materials (Amory, 2010a), concentrate on information over the learning process (Paulsen, 2003), and replicate traditional instructional practices (Blin & Munro, 2008; Browne, Jenkins, & Walker, 2006; Dutton et al., 2004; Yueh & Hsu, 2008). Amiel and Reeves (2008) argue that technology should be an integral part of the learning process rather than an isolated unit of learning.

However, teachers encounter challenges beyond LMS design when integrating technology and media into their teaching practices. For instance, pre-service teachers designing text-based web quests and PowerPoint presentations often focus on lower-order thinking skills, overlooking the ideological dimensions inherent in all media (Reid et al., 2006). Media content employs symbols and signs that are not politically neutral, objective, or impartial, often perpetuating dominant cultural values (Torres & Mercado, 2006). Mitchell (2008) highlights that contemporary media theory is often associated with themes of war machines, coercion, aggression, surveillance, and propaganda, as described by McLuhan's "the medium is the message". On the other hand, Gibson (2008) argues that the meaning or message of content is shaped by the ways in which we use media.

This paper investigates the integration of media (content), educational technology, and interactive learning environments into instructi onal designs that align with the current dominate pedagogical paradigm of sociocultural dialogic activity (Vygotsky, 1933/1978). Additionally, the paper briefly introduces the aforementioned framework and reviews illustrative examples to highlight its essential aspects.

The framework employed in this study incorporates three key elements: Cultural-historical activity theory (C), Authentic learning (A), and potential roles of educational Technology (T) in the context of teaching and learning. Vygotsky's theory (1933/1978) posits that learning is never a direct process but rather occurs through the mediation of cultural and psychological tools. These tools act as intermediaries through whom we acquire knowledge about the world, enabling us to develop mastery over our surroundings and ourselves. Engeström (1987) expanded Vygotsky's subject-object-tool triad to include additional components such as rules, the community, and division of labor, providing a more comprehensive understanding of human activity and work (as depicted in Figure 1). Central concepts associated with this socio-cultural dialogic activity framework include the object of activity, social interactions, and mediation.

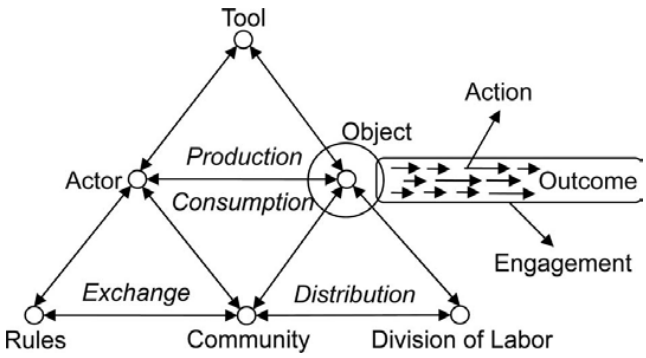

Figure 1. Redrawn from Engeström (2008), the Activity System Diagram Depicts the Framework: Activity System Diagram

The central focus in activity theory is the object and its associated actions (Engeström, 2008). However, Kaptelinin (2005) points out that the object can hold different meanings: "objekt" refers to material entities that exist independently of the mind (representing something to be realized), while "predmet" denotes a thought or action (representing the object of desire). It is essential to distinguish that the motive behind the activity is not solely the object. When we instantiate an object, we formulate it, and we realize an object when we achieve a particular outcome (Nardi, 2008).

Socio-cultural interactions play a fundamental role in cognitive development, as Vygotsky (1933/1978) posits that every function in a child's cultural development occurs twice: first between people (interpsychological) and then internally within the child (intra-psychological).

In the mediation of knowledge construction, psychological and cultural tools are of utmost significance. According to Wertsch (2007), mediation encompasses two formulations: explicit mediation, where a stimulus is intentionally introduced into an ongoing activity stream, evident and non-transitory; and implicit mediation, which relies on signs, especially language, primarily serving the function of communication. Hence, within the activity framework, we must give meticulous attention to two essential components. Firstly, the design of a learning activity should prioritize an easy-to-use approach when creating the object of the activity (the design of the learning actions). Secondly, the role of technology and media/content in the system requires clarity. Amory (2012) proposes that authentic learning could aid in describing the object of the learning activity and suggests various ways in which technology could be effectively integrated into such a system.

According to Reeves et al. (2004), well-designed learning environments should include authentic tasks that possess certain characteristics. These tasks should have real-world relevance, be ill defined with multiple subtasks, and require students to engage in complex investigations. Additionally, they should offer opportunities for students to explore the tasks from various perspectives, foster collaborative and reflective learning experiences, and integrate different subject areas. The assessment should also be integrated into the tasks, allowing for the generation of multiple iterations of potential products and

accommodating diverse and competing answers or solutions.

Technology assumes various roles within the system, encompassing the delivery of learning resources, research materials, and administrative information essential for educational processes. It also acts as a facilitator of communication, accommodating both real-time synchronous interactions and asynchronous interactions for anytime collaboration. Collaborative authoring and other online services enable co-authorship and co-construction of content, as exemplified by Google Docs, where multiple authors can simultaneously edit documents.

Moreover, technology serves as an information transformation tool, enabling the conversion of information from one or multiple sources into alternative streams. For instance, a written novel could be transformed into a storyboard using technology. Additionally, it functions as a professionalization tool, offering specific technological tools directly associated with particular professions. For example, architecture students might use computer-aided design software to enhance their professional skills. Explicit mediation, where a stimulus is intentionally introduced into an ongoing activity stream, evident and non-transitory; and implicit mediation, which relies on signs, especially language, primarily serving the function of communication. Hence, within the activity framework, we must give meticulous attention to two essential components. Firstly, the design of a learning activity should prioritize an easy-to-use approach when creating the object of the activity (the design of the learning actions). Secondly, the role of technology and media/content in the system requires clarity. Amory (2012) proposes that authentic learning could aid in describing the object of the learning activity and suggests various ways in which technology could be effectively integrated into such a system.

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2. Methods, Results and Discussion

The research utilized a collective case study approach to evaluate the effectiveness of the object-tool-social framework in incorporating video games into the teaching and learning process. The case studies can be categorized into three types based on their objectives: intrinsic studies, which explore the uniqueness of individual cases; instrumental studies, which aim to advance theoretical understanding; and collective studies, which employ multiple cases to serve an instrumental purpose (Stake, 1988).

In this particular study, the unit of analysis for individual cases was the understanding of pre-service teachers regarding the use of video games in the classroom. Simultaneously, the collective case analysis aimed to develop a theoretical foundation for leveraging video games in teaching and learning. Five individual case studies were reviewed to achieve this purpose (Creswell, 1998).

These case studies encompassed various scenarios, such as rural school students playing a game to overcome misconceptions related to photosynthesis and respiration (Case 1), orphans from Soweto engaging in an interactive game to learn about diseases (Case 2), third-year BEd students using a game to design a learning intervention (Case 3), Postgraduate Certificate in Education (PGCE) students using a game to address misconceptions related to Mendelian genetics (Case 4), and education students at honors level undertaking authentic tasks to enhance their understanding of technology use in the classroom (Case 5).

2.1. Case 1

During the study, two groups of Form 3 students from Kang BOU Centre engaged in playing an adventure game designed to address misconceptions related to photosynthesis and respiration (Foko & Amory, 2008). The results, as shown indicated that individual play (n=19) led to only 31.9% of the concepts being understood by the participants. Interestingly, it was observed that those who couldn't solve the game puzzles memorized the answers from their peers who could. Additionally, some participants faced difficulties comprehending the English test instrument.

In the second group (n=16), the students played the game in pairs, and they were given the opportunity to seek language clarification during gameplay. This collaborative approach and the provision of language assistance led to a noticeable improvement in test scores, with 50% of the concepts being understood.

Overall, the findings highlight the importance of collaboration and language support in enhancing learning outcomes when using video games as a tool for overcoming misconceptions related to photosynthesis and respiration among Form 4 students at Gaborone Secondary School.

2.2 Case 2

Botswana Open University's Kang Regional Centre Teenage participants, consisting of orphans from Kang aged 14 to 18 years (n=12), took part in playing an adventure game focused on the biology of

various diseases, including HIV/AIDS and tuberculosis. The participants were divided into groups of three members, and each group played the game for a total of 10 hours (Amory, 2010b). Knowledge gained through gameplay was then assessed and compared to the performance of first-year biology students and first-year non-biology students.

Comparing Teenagers' Understanding of Biology in Various Diseases after Gameplay with First-Year University Students (Biology and Non-Biology) at the University of Botswana (UB).

Table 1. Teenage Participants

Group	Mean Score ± SD (%)
Teenage Participants	57.1 ± 8.9
First-year Biology	61.4 ± 10.2
First-year Non-Biology	37.6 ± 8.1

The results indicate that the average scores of the teenage participants were comparable to those of the first-year biology students (57.1 ± 8.9% vs. 61.4 ± 10.2%). In contrast, the first-year non-biology students scored significantly lower at 37.6 ± 8.1%. The difference between the teenage participants' scores and the first-year non-biology students' scores was statistically significant (t-test=-7.982, DF=116, $p < 0.001$).

It's worth noting that one group of teenage participants preferred not to collaborate and was the only group that did not complete the game. The findings indicate that gameplay in this adventure game effectively enhanced the participants' understanding of biology-related diseases, with their performance comparable to that of first-year biology students.

2.3 Case 3

In Case 3, third-year BEd students (n=184) participated in playing an adventure game aimed at exploring an object-social Vygotsky framework (Amory, 2011). The gameplay was conducted in pairs. As part of the examination, participants were tasked with submitting three of the semester tasks they considered most beneficial for their personal development.

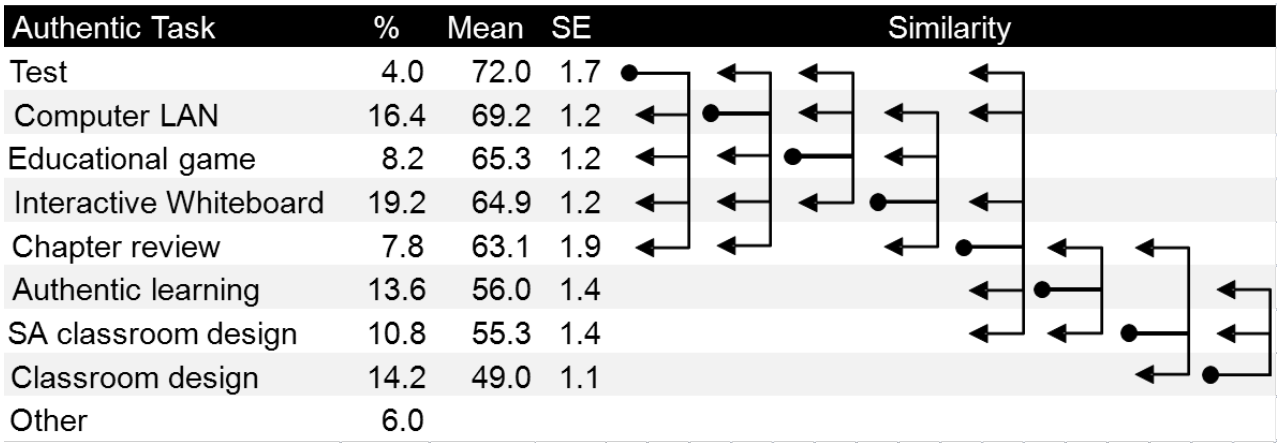

Figure 2. Presents the Performance of Third-Year Students in Various Aspects of the Course, including Course Work, Authentic Tasks, and Examination Portfolio Tasks

Examination of the participant portfolio outcomes (Figure 2) revealed that certain individuals found significant value in playing the educational game. Upon analyzing the reasons for this preference, they expressed that they experienced enhanced learning outcomes when engaging in collaborative gameplay. Additionally, some participants identified the primary objective of the activity as "evaluating the game for learning".

2.4 Case 4

Assessment of Misconceptions in Genetics among PGCE Students Before and After Gameplay

Table 2. Assessment of Genetic Misconceptions among PGCE Cohort

Test	**Mean Score ± SD (%)**
Pre-test	| 29.8 ± 4.7
Post-test	44.4 ± 6.5
** Significantly different, t-test=-3.69, $p < 0.001$	

Life Science PGCE students (n=11), divided into pairs, played an adventure game designed to rectify misconceptions related to Mendelian genetics (Amory, 2011). The evaluation of their understanding before and after gameplay showed a significant improvement. Their mean score increased from 29.8 ± 4.7% in the pre-test to 44.4 ± 6.5% in the post-test (t-test=-3.69, $p < 0.001$). The students recognized that the game puzzles acted as a tool, facilitating discussions between team members and mediating their learning process. The interactive gameplay significantly contributed to their understanding of difficult Mendelian genetic concepts.

2.5 Case 5: Authentic Tasks and Tools in an Honours Level Education Course

Unlike the previous cases that utilized complex adventure games for mediating knowledge construction,

this case employed various authentic tasks, core readings, and software tools in an education course at the honours level. The authentic tasks encompassed activities such as evaluating e-maturity at a school using Google Docs, presenting software tools to support e-maturity via Google presentation, creating a knowledge, skills, and attitudes mind map using Free Mind, designing a website on open source and open access materials in schools through Weebly, and developing a film script for a future educational system using a storyboard.

At the conclusion of the semester, participants were asked to assess the authenticity of the course (Amory, 2012). Additionally, their performance was evaluated in comparison to similarly designed courses (research methodology) and dissimilarly designed courses (education theory).

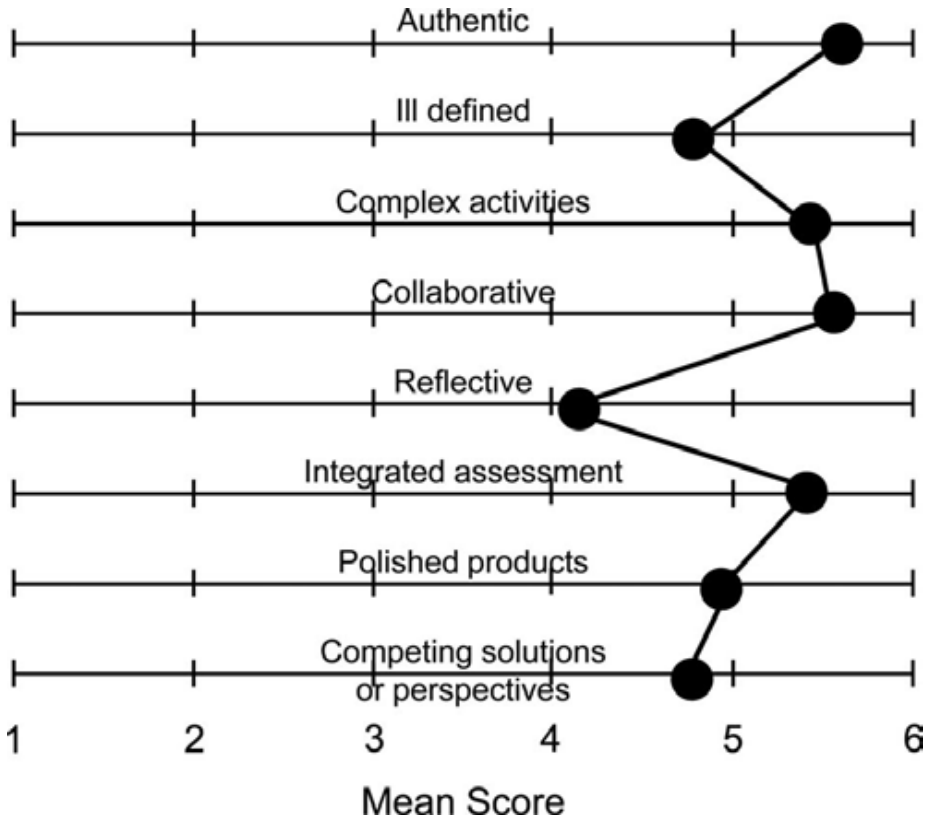

Figure 3. Student Assessment of Authentic Task Design Principles

All the authentic attributes of the course, except for reflections, received high ratings from the participants.

Table 3. Descriptive Statistics for Different Courses

Course	Participants	Mean Score (%)	Standard Deviation
Educational ICT	30	60.73	10.66
Research Methodology	30	56.07	16.48
Education Theory	30	50.07	11.33

The results of a 1 x 6 x 3 repeated measures analysis of variance revealed significant differences between three different courses: Educational ICT, Research Methodology, and Education Theory. Post hoc pairwise comparisons indicated that both the Educational ICT and Research Methodology courses differed significantly from the Education Theory course ($p=0.0001$ and $p=0.006$, respectively). However, there was no significant difference between the Educational ICT and Research Methodology courses ($p=0.25$).

3. Conclusion

The research reviewed here leads to three significant conclusions:

Firstly, when introducing game puzzles, core reading, and suitable software into a learning activity, these elements act as the extrinsic mediator, while the discussions among players intrinsically mediate their comprehension.

Secondly, artefacts, including games, media, and software, contribute to knowledge production when utilized as tools rather than mere objects of the activity.

Thirdly, the Vygotskian concept of social tool-mediated dialogical knowledge construction emerges as an appropriate framework for incorporating games and media in teaching and learning.

These findings provide valuable support for the design of learning objects within activities applicable to both residential and distance education systems. Implementing these principles can enhance the overall learning experience and foster meaningful knowledge acquisition for students.

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I am deeply grateful to my family, whose unwavering support and understanding have been a constant source of motivation throughout this journey. Their encouragement and belief in my abilities have pushed me to excel and complete this work.

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