Digital Curation in Science Education: A New Learning Pathway to Contribute Student Engagement with Socio-Scientific Issues (Short Paper)

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אוצרות דיגיטלית בחינוך מדעי: דרך למידה חדשה לתרומה על מעורבות התלמידים בסוגיות חברתיות-מדעיות (מאמר קצר)

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Abstract

Science education has recently transitioned from focusing on delivering scientific knowledge to actively engaging students with socio-scientific issues (SSI) directly connected to their daily experiences. This study examined digital curation (DC) as a teaching and learning SSI practice and its contribution to high school science students' engagement. DC requires students to evaluate digital resources' quality, reliability, and authenticity, resulting in meaningful content collections on specific subjects. This case study involved four secondary school teachers and 25 students, where teachers designed instructional units focused on SSIs using DC and applied them in classrooms. Data collection included teacher reflective reports and interviews with teachers and students. Content analysis revealed that it contributed to agentic, social, behavioral, cognitive, and emotional engagement. These findings suggest that DC can contribute to student engagement, with practical implications for science educators in integrating real-world issues in the science classroom.

Keywords: Digital curation, students' engagement, science teaching, socio-scientific issues, online learning.

מילות מפתח: אוצרות דיגיטלית, מעורבות תלמידים, הוראת מדעים, סוגיות חברתיות-מדעיות, למידה מקוונת.

Introduction

Over the past two decades, science education shifted from presenting scientific knowledge to actively involving students in socio-scientific issues (SSIs). These SSIs are real-world dilemmas that often intersect science with social, political, and ethical concerns. The context-based learning model has emerged as a critical approach in this educational shift, where students are encouraged to analyze and reason through socio-scientific dilemmas critically, thus improving scientific understanding and engagement (Sadler et al., 2016). Context-based learning allows students to apply scientific knowledge to authentic, real-world issues, making science education more relevant and meaningful. Previous research has extensively explored the integration of SSIs into science education curricula, demonstrating its positive contributions to students' cognitive, emotional, and social engagement (Zeidler, 2014). One of the most important components of SSI education is the development of students' critical thinking skills, which enables them to analyze complex issues, evaluate evidence, and engage in ethical reasoning (Ratcliffe & Grace, 2003). Recent studies have also highlighted the growing role of digital platforms in SSI learning, emphasizing that students need to navigate vast sources of online information (Klosterman et al., 2012). However, the challenge lies in ensuring students can evaluate online information's credibility, authenticity, and relevance (Rawson Lesnefsky et al., 2023). Digital curation (DC) is the systematic process of selecting, organizing, and preserving digital items to create collections that provide valuable, pertinent information on a specific subject (Tsybulsky, 2020). While DC is widely used in professional and academic contexts, its use in educational settings, particularly in science education, is relatively new (Gadot & Tsybulsky, 2023; Dayan, Gadot, & Tsybulsky, 2023). The integration of DC in teaching SSIs offers a unique opportunity to contribute to student engagement by fostering scientific inquiry and digital literacy (Dayan & Tsybulsky, 2024). Thus, this study explores how DC as an instructional tool can contribute to engagement in science education through the lens of SSI-based learning.

Research Aim

This study investigated whether integrating DC into SSI teaching can contribute to students' engagement in multiple dimensions. Specifically, the study focused on five key dimensions of engagement: cognitive, behavioral, emotional, social, and agentic. Each dimension reflects a different aspect of how students interact with learning material.

Methodology

The research followed a qualitative case study approach, selected for its ability to explore complex phenomena within their real-life context (Yin, 2003). Four secondary school science teachers and 25 students participated in the study. The teachers from different schools participated in a 30-hour professional development (PD) program focused on digital curation in science education. During the PD, teachers were introduced to digital curation and developed SSI-based instructional units that integrated DC. These instructional units were then implemented in their classrooms. The case study method was particularly suited to this research, as it allowed for an in-depth exploration of the contribution of DC on student engagement across multiple dimensions.

The 25 students were divided into small groups and asked to curate digital collections on one of three SSI topics: energy drinks, hybrid vehicles, or solar energy. The teachers provided minimal guidance during the curation process, allowing students to take ownership of their learning.

Data were collected through three primary sources: teacher reflective reports, semi-structured interviews with teachers, and semi-structured interviews with students. The reflective reports provided insights into the teachers' perspectives on how DC influenced student engagement. In contrast, the interviews with teachers and students explored the challenges and benefits of integrating DC into SSI teaching. The student interviews, in particular, focused on the student's experiences with digital curation, including how they selected and evaluated digital resources, collaborated with their peers, and how the process influenced their engagement with the SSI topics.

The data from the reflective reports and interviews was analyzed using content analysis. The content analysis focused on identifying instances of student engagement across the five dimensions of engagement: cognitive, behavioral, emotional, social, and agentic. The coding process was iterative, with multiple rounds of coding to ensure accuracy and reliability.

Findings

The findings indicated that teaching and learning through SSI-DC contributes to students' multi-dimensional engagement (Table 1):

Table 1. Dimensions of Student Engagement and Teacher Observations During Digital Curation of Socio-Scientific Issues

Engagement Dimension	**Students Examples**	**Teachers Observations Examples**
Cognitive Engagement – deep thinking and analysis	Students demonstrated contributed cognitive engagement by critically evaluating the reliability of the digital resources they encountered. Several students reflected on the importance of distinguishing between credible and non-credible sources, and they reported feeling more confident in their ability to assess the quality of information. *"We decided to add important information that responded to all the questions related to the effects of energy drinks on human health, such as what these drinks are made of, the types of ingredients, and their effects."*	Teachers emphasized evidence-based reasoning and reliable digital sources to strengthen scientific arguments. *"The discussions about the issues and the students' arguments showed me that they had augmented their scientific knowledge in relation to the SSI."*
Behavioral Engagement- sustained effort and participation	Students exhibited sustained behavioral engagement, persistently completing the digital curation tasks.	Teachers noted that students continued to work on their collections outside of class hours, often collaborating via online platforms to complete the project. This indicated a high level of investment

	"We started working in the classroom during biology class in the computer room. After we got familiarized with the topic and played around with it the whole group worked together on Zoom in our free time."	in the task beyond the typical classroom expectations. *"They studied together even after school hours. They met together in the afternoon, which suggests that they enjoyed the DC, they were active and talking constantly."*
Emotional Engagement- emotional involvement and interest	Students expressed increased interest in the SSI topics, particularly those relevant to their lives. *"I got new information that resulted in significant changes in my lifestyle, I recommend DC because it is a different and novel way of teaching and learning."*	Teachers emphasized that emotional engagement stemmed from students' enthusiasm and interest in the curation activity. Students enjoyed the task, felt motivated, and actively participated, especially when relevant to their lives. *"I had concerns that I would overload them or that they would not be interested in the task... but surprisingly, they were really enthusiastic..."*
Social Engagement- collaboration with peers	Students worked together to curate their collections. Several students commented on the value of learning from their peers, and teachers observed that the group discussions were more dynamic and student-led than traditional classroom activities. *"The cooperative work, the peer learning between us... we learned from each other; we helped each other."*	Teachers observed that the group discussions were more dynamic and student-led than traditional classroom activities. *"It was very important for them to go through this shared experience where everyone contributes their own ideas. Working together is an important part of the world today.... But beyond that, I saw sharing between groups, and it was lovely."*
Agentic Engagement- taking initiative in the learning process	Students actively sought additional resources beyond the teachers provided to include in their collections. This demonstrated a high level of autonomy and self-directed learning, with students feeling empowered to make decisions about the content of their digital collections. *"I chose this topic to learn more about it and form my personal opinion. It is important to me on a personal level".*	Teachers emphasized students' active, independent engagement in their learning, where they took initiative, curated content, and expressed personal opinions with minimal guidance. *"During the lesson, they learned independently and did not expect me to spoon-feed them... At some point, I felt I had become a guide and not a teacher, and this is a big plus."*

Discussion

The results of this study revealed the potential of DC as a teaching tool in science education, particularly in the context of SSIs. The findings align with previous research highlighting the importance of engaging students with real-world problems with scientific and social dimensions (Sadler et al., 2016; Dayan & Tsybulsky, 2024). By integrating DC into SSI teaching, students could engage more deeply with the content by acquiring knowledge and critically evaluating

information, collaborating with peers, and taking initiative and responsibility in their learning, a critical factor in promoting lifelong learning.

This study also contributes to the growing body of research on the role of digital tools in science education. As digital literacy becomes increasingly important in the 21st century, educational strategies that promote digital skills, such as DC, are essential. The findings suggest that DC contributes to students' engagement with scientific content and prepares them for the challenges of navigating the vast information available online. By teaching students how to assess digital resources critically, educators can equip them with the tools they need to become informed citizens and lifelong learners.

Conclusion

This study has demonstrated that DC can be an effective instructional strategy for contributing to student engagement in science education, particularly in the context of SSIs. By fostering five multidimensional engagements, DC helps students develop critical thinking skills, collaborate with peers, and take ownership of their learning. Integrating DC into SSI teaching also has broader implications for developing digital literacy skills, which is essential for navigating the increasingly complex digital landscape. Future research should explore the long-term contributions of DC to student engagement and learning outcomes and its potential for use in other subject areas. Additionally, quantitative studies with larger sample sizes would provide further insights into the effectiveness of DC as a teaching tool.

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