

IMPROVING THE EDUCATIONAL PROCESS OF HIGHER EDUCATION INSTITUTIONS THROUGH THE USE OF DIGITAL TECHNOLOGIES

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Abstract

This study proposes the concept of learning ecologies, which guide students' knowledge acquisition and learning processes through digital-material technologies. These ecologies enable students to independently navigate their learning pathways. The research highlights that students' learning processes are not limited to course contexts but extend to searching for knowledge and resources outside of these contexts. This assumption is examined in the context of two higher education courses: software engineering and teacher education.

The qualitative research findings indicate that digital and material tools play a crucial role in students' learning processes and significantly influence how they learn and engage in activities. The study suggests that pedagogical practices in higher education should better integrate digital technologies to enhance learning opportunities for students.

Keywords: qualitative research, learning ecologies, higher education, student learning, digital technologies.

Introduction

In recent years, higher education programs have increasingly focused on preparing students to become knowledgeable members of the workforce. This involves developing students' abilities to process, analyze, and apply knowledge—often in contexts beyond formal education settings. As a result, learning processes may occur across various environments, including formal educational contexts as well as professional and personal domains. In such cases, educational curricula create connections between academic knowledge and professional practices.

Overall, these activities help students succeed in knowledge-intensive careers, prompting many academic programs to integrate such learning experiences into their curricula. Recent studies show that acquiring knowledge across different contexts and engaging effectively with digital tools is not always easy for students. Therefore, more research is needed to better understand and support student engagement in these kinds of learning activities.

Literature Review

This study analyzes the learning activities of undergraduate students in the fields of software engineering and teacher education. These activities are carried out in contexts outside the students' formal educational institutions, where digital technologies play a significant role in the learning process. In the Norwegian context, teacher education and software engineering are considered high-priority academic fields. National regulations regarding teacher education stipulate that the monitoring and assessment of student learning must be conducted not only by school mentors but also by university staff.¹ While these expectations might appear simple, research indicates that ensuring continuous support focused on the development of students' knowledge and competencies is a challenging endeavor.² Although these expectations may appear straightforward at first glance, empirical research indicates that providing continuous and effective support tailored to the advancement of students' knowledge and professional competencies remains a complex and challenging task. Sustained guidance is necessary to help students navigate their learning journeys successfully, yet implementing such support mechanisms consistently is far from simple.

Furthermore, in the domain of software engineering, the essential knowledge that students are required to master is often disseminated through diverse online platforms, including specialized professional databases, discussion forums, and other digital resources. These distributed learning materials demand a high level of learner autonomy, digital literacy, and the ability to critically evaluate and integrate information from multiple sources. This decentralized nature of knowledge acquisition further complicates the educational process, highlighting the importance of well-structured learning ecosystems and support frameworks that can assist students in managing and optimizing their learning pathways.³ For students, understanding the availability of these resources and knowing where and how to effectively utilize them is crucial. Equally important is the development of essential technical skills and the ability to use digital tools proficiently, especially when working on authentic engineering projects. These competencies enable learners to engage deeply with real-world tasks, navigate complex problem-solving environments, and apply theoretical knowledge in practical contexts. Thus, fostering these skills and digital literacy becomes a key component in preparing students for professional success in the field of software engineering.⁴

¹ Det Kongelige Kunnskapsdepartementet (Ministry of Education and Research) (2016-2017). Lærelyst- tidlig nnsats og kvalitet i skolen. White Paper, Retrieved March 2017 from <https://www.regjeringen.no/Lang>, C., Siemens, D., Wise, A., & Gasevic, D. (2017). Handbook of learning analytics, 1st ed., Creative Commons License 4.0, DOI: 10.18608/hla17

² Hill, H. C., & Grossman, P. (2013). Learning from teacher observations: Challenges and opportunities posed by new teacher evaluation systems. *Harvard educational review*, 83(2), 371-384.

³ Nerland, M. & Jensen, K. (2010). Epistemic practices and object relations in professional work. *Journal of Education and Work*, 25(1), 101- 120

⁴ Litzinger, T., Lattuca, L. R., Hadgraft, R. and Newstetter, W. (2011), Engineering Education and the development of Expertise. *Journal of Engineering Education*, 100, 123-150.

Methodology

From an empirical perspective, it is essential to develop an understanding of how students form their learning ecosystems and how they orient themselves within these environments. This involves the collection and self-organization of various elements such as goals, knowledge, locations, resources, tools, activities, and/or institutional requirements. These processes are intricately linked to the opportunities provided by contemporary knowledge, practices, and technologies. Moreover, it is expected that students' attitudes and behaviors significantly influence how they engage with and navigate these ecosystems. Methodologically, the research aims to gather information from multiple sources to explore how students create and shape their learning ecosystems. This multifaceted approach allows for a comprehensive understanding of the dynamic interactions between learners and the educational contexts they inhabit.

Analysis and Results

The issues described in this study possess both practical and academic significance. For instance:

- learning takes place across various locations—on campus, within online learning systems, or at internship schools;
- the complex practical tasks that students must master often require continuous support from instructors;
- effectively managing these processes necessitates the use of various digital technologies.

Taking into account the dynamic nature of learning environments, this research analyzes how students utilize digital technologies to access learning opportunities and address the challenges they encounter. The study aims to understand how learners navigate and solve problems within these evolving contexts by leveraging digital tools.

The primary aim of this study is to analyze how students' learning activities unfold at the intersection of various educational settings and to examine the role that digital technologies play within these processes. This article presents empirical evidence drawn from two separate research projects conducted to explore these objectives: one focusing on teacher education and the other on software engineering education.

Table 1. Key Aspects and Trends of Learning with Digital Technologies in Higher Education

No	Aspect	Description	Examples
1	Digital tools	Technologies used for education and teaching	Tablets, online platforms, video tools, LMS (Learning Management Systems), e-books
2	Learning environments	Places or contexts where digital learning occurs	Classrooms, virtual classrooms, online forums, collaboration tools
3	Student participation	Interaction of students with digital technologies during the learning process	Active participation in online discussions, using digital tools for research, collaborating on virtual projects

No	Aspect	Description	Examples
4	Pedagogical practices	Teaching strategies integrated with digital technologies for learning	Flipped classrooms, blended learning, learning through collaboration with online tools
5	Advantages of digital tech	Positive outcomes of integrating digital tools in education	Expanded access to resources, personalized learning, enhanced collaboration
6	Challenges	Difficulties encountered when using digital technologies for education	Issues with digital literacy, inequality in access to technology, insufficient teacher training on digital tools
7	Future trends	Emerging directions in the use of digital technologies in higher education	Use of artificial intelligence in education, immersive learning experiences with virtual reality (VR) and augmented reality (AR)

The aspects outlined in Table 1 highlight how digital technologies influence the learning process in higher education and illuminate its various dimensions. Digital tools create broader opportunities for students to acquire knowledge by providing an interactive and adaptive learning environment. However, effective use of these technologies depends significantly on students' digital literacy and instructors' appropriate pedagogical approaches.

In the future, digital technologies, particularly innovative tools such as artificial intelligence (AI) and virtual reality (VR), are expected to further advance the educational process. Therefore, the proper application of digital technologies in higher education enables students to engage in a more efficient and interactive learning experience.

In the field of software engineering education, an introductory course titled "Web Project" was observed. This course utilized various learning and teaching methods to teach students the fundamental skills of programming. Classes and laboratory sessions were held once every two weeks, and there was a four-week collaborative web development project.

Students were required to work in groups to create a functional website. For programming tasks, students made use of online platforms and resources such as W3Schools and Stack Overflow. Additionally, they used the GitHub platform to save their code and collaborate with each other effectively. For communication, Facebook groups were used, while Dropbox served as a tool for saving and sharing their work.

In the teacher training program, students were assigned the task of observing activities at internship schools and collaboratively developing lessons. The students worked in pairs. The teachers visited them twice to provide guidance and support.

Students were provided with tablets, which they used to record videos of each other's teaching activities. These videos were securely stored on a protected server and could be accessed online by the students themselves, their peers, university instructors, and school mentors. Comments could be added to the videos as annotations, and all participants were able to edit and contribute to these comments collaboratively.

The research data set consisted of the following:

- a) Interviews with students and observers regarding the use of tablets and video recordings in teacher training;

b) Records of group meetings, online communications, website prototypes, and final website videos in the software engineering education course.

A qualitative content analysis was conducted to explore the following issues:

a) how students used technologies to complete learning tasks and to work or communicate across different locations;

b) how they accessed and applied digital technologies;

c) how students experienced learning and working processes through digital technologies.

Key aspects emerged from the data through an inductive approach

Drawing on theoretical frameworks, we examined the interactions between activities and digital technologies, with a focus on how these interactions contributed to students' learning processes. As a result, a number of interesting concepts emerged, which hold both practical and theoretical significance.⁵

Conclusion

Initial findings indicate that the digital materials and tools used in students' learning processes (such as tablets, videos, online platforms, and digital repositories) serve as important resources in the educational process. These tools provide students with access to new sources of knowledge, enabling engagement with resources and activities that would otherwise be inaccessible.

In the software engineering study, coding strategies and reference materials offered students new options and inspiration. The integration of tablets and video recordings, along with consistent guidance, enhanced the role of technology in shaping students' engagement with knowledge and resources.

Future research should explore how digital technologies can support more connected and integrated learning processes, as well as develop tools for analyzing these technologies. In pedagogical practice, it is important to naturally embed digital technologies into the learning process and support students in effectively acquiring the necessary knowledge.

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