Asynchronous Educational Modules as a tool for Knowledge Transfer on the Example of a Technical University

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Abstract: This article analyses the functioning of asynchronous e-learning modules in higher education, using the Częstochowa University of Technology in Poland as an example. The aim of the study was to understand student experiences, identify the benefits of flexible learning, and identify challenges related to the lack of direct interaction with instructors. The method of social research using a questionnaire and quantitative methods were used. The study, conducted in 2025, involved 263 students from various fields, including management, logistics, and business finance. The results indicated very high ratings for time flexibility and the availability of teaching materials. Quantitative analysis demonstrated user satisfaction with the technical quality of the courses and their practical relevance. At the same time, barriers were identified, such as difficulty maintaining motivation and a sense of isolation resulting from the lack of face-to-face contact.

Keywords: Education, Knowledge transfer, Knowledge sharing, Higher education, Motivation, Asynchronous, e-Learner

1. Introduction

Distance education, although often associated with modernity, has a nearly century-long tradition. As early as the 1920s, "educational radio" was utilized in the teaching process, and after 1945, "educational television" developed dynamically, with the initiatives at Iowa State University serving as a pioneering example (Kossobucka, 2011). Early stages of distance learning relied primarily on the traditional transfer of knowledge through the postal mailing of instructional materials, textbooks, and specialist journals. These forms, despite their pioneering role in democratizing access to knowledge, were characterized by a lack of interactivity and direct engagement between the teacher and the student. According to Kotarba (2024), the history of distance learning dates back almost three centuries. Its beginnings are considered to be 1728, when American professor Caleb Philipps published an offer for a shorthand course in the Boston Gazette. This pioneering method was based on the systematic mailing of original teaching materials. The institutional development of this model progressed globally: from the first correspondence school in England (1840), through centers in Berlin (1856) and the United States (1860), to Polish initiatives in 1916. It is worth noting that as early as 1914, Norway was the first to introduce legal regulations sanctioning this mode of learning (Dziewulak, 2020), which demonstrates an early recognition of distance learning's potential in building social capital. In 1969, The Open University was established in Great Britain, using a distance learning model based on Life-Long Learning, with the aim of supporting working students, regardless of age, in the education proces (Galwas et.al., 2020)

The technological breakthrough occurred with the popularization of the Internet in the second half of the 20th century, which fundamentally changed the dynamics of communication processes. This progress eliminated geographical barriers, making education universally accessible and transforming it into a tool for the mass development of human capital. Contemporary digitalization has not only intensified the pace of learning but, above all, has contributed to the formation of a new educational paradigm. In this approach, the acquisition of knowledge ceases to be a phase locked in time and becomes a continuous process, increasingly implemented through flexible, asynchronous, and synchronous educational systems adapted to the demands of the modern economy. New technologies influence not only the changing labor market but also shape unprecedented needs and opportunities in education. Access to knowledge in today's world is practically unlimited. What matters is not how we develop our skills, but rather that we want to do so. The key to success is versatility and openness to improving competencies, as well as life-long learning, a learning process that lasts a lifetime. In an era of widespread digitization and dynamic technological progress, distance learning has become an integral element of the education system. Given the ease of access to information resources, it's difficult to expect this trend to slow down in the foreseeable future.

The contemporary educational landscape of the 21st century is shaped by the dynamics of the Fourth Industrial Revolution, where traditional teaching methodologies are giving way to ubiquitous digitalization. Today’s schools and universities operate in a reality where mobile technologies and artificial intelligence (AI) have ceased to be mere technical curiosities, becoming instead fundamental tools for organizing the didactic process. Generative language models, adaptive algorithms that tailor the pace of learning to individual student needs, and universal access to knowledge via smartphones are redefining the role of the educator—shifting it from the sole source of information to a guide through the digital world. A vital element of this transformation is

gamification—the integration of game mechanics into the educational environment—which drives a quantum leap in student engagement and intrinsic motivation.

This rapid technological advancement brings both unprecedented opportunities and significant risks. The undeniable advantages of digital education include inclusivity, instantaneous knowledge verification, interactivity, and the elimination of geographical barriers. Conversely, embedding education within virtual spaces exposes numerous drawbacks. Key challenges include the digital divide, shortened attention spans, the risk of screen addiction, and the proliferation of misinformation alongside a superficial acquisition of knowledge. Furthermore, the automation of tasks through AI raises crucial questions regarding independent critical thinking and the authenticity of student-produced work.

Distance learning is typically used for lectures. Students can participate from anywhere in the world. The instructor can monitor students' progress. Distance learning allows for adapting course materials and teaching methods to various learning needs.

After analyzing the literature, it was decided to conduct a study to answer the following research questions:

Research Question 1. How do students assess the effectiveness of asynchronous learning as an educational mode?

Research Question 2. What are the main challenges and limitations students face in online learning environments?

Research Question 3. How do students perceive the adaptability of online learning, and what conclusions can be drawn from their perspective?

This article analyzes the functioning of asynchronous modules using the example of students from the Częstochowa University of Technology, focusing on the experiences of students from the Faculty of Management. The first part of the article presents the theoretical foundations of the concept of asynchronous learning. The next section describes the empirical research procedure, presents the results of the conducted research, and identifies barriers that may exist in asynchronous learning. Finally, an analysis and discussion are presented, followed by conclusions and recommendations for future research.

2. Literature Review

Higher education institutions serve as quintessential exemplars of knowledge-based organizations, leveraging intellectual capital to secure a competitive advantage and facilitate societal knowledge acquisition (Krawczyk, 2024). To meet evolving socio-economic demands, universities increasingly operate as open and adaptive entities. The dynamic evolution of information technologies, coupled with shifting paradigms in higher education, necessitates the implementation of flexible pedagogical methodologies (Al-Rahmi, 2021). Within this context, asynchronous educational modules have emerged as a pivotal mechanism supporting knowledge transfer and human capital development, particularly within technical universities. By liberating the instructional process from rigid temporal constraints, this model directly aligns with the tenets of lifelong learning (Zotova et al., 2021).

Although digital transformation was already underway, e-learning experienced exponential growth following the 2020 COVID-19 outbreak, which abruptly restricted traditional face-to-face instruction globally (Dias et al., 2020; Omar, 2021; Raza et al., 2021; Gamage et al., 2022). This sudden public health crisis caught educational systems unprepared, leaving a profound and enduring impact on institutional operations (Bozkurt et al., 2022). To comply with physical distancing mandates, institutions were compelled to pivot rapidly to remote environments, disrupting conventional forms of pedagogy, assessment, research, and scholarly discourse (Byrnes et al., 2021; Mohd Basar et al., 2021). Remote learning—defined as the synchronous or asynchronous delivery of curricula via distance education techniques—obviates the need for physical classroom presence through the strategic utilization of information technology (Omirzak et al., 2021). A primary objective of this modality is to democratize education by expanding access for individuals facing geographical, professional, familial, or health-related barriers (Buabeng-Andoh, 2021; Iwan, 2025). Furthermore, online collaborative learning extends pedagogical boundaries beyond physical spaces, fostering interpersonal relationships and cooperative environments that allow students to progress at an individual pace (Papachristos et al., 2010). Nevertheless, the medium presents notable challenges, including reduced social interaction, technical impediments, and heightened risks regarding academic integrity (Naseer, 2023).

In contemporary literature, online education is frequently analyzed through the dichotomy of synchronous and asynchronous approaches, which differ fundamentally in terms of location, timing, and the nature of instructional activities (Fabriz et al., 2021). Synchronous teaching typically mandates live, real-time engagement at designated intervals, whereas asynchronous learning encompasses temporally decoupled activities, such as independent reading, video consumption, and assignment completion. Empirical research yields no definitive consensus establishing the superiority of one modality over the other regarding student engagement or learning outcomes; rather, their efficacy remains highly context-dependent, contingent upon the students' age and level of cognitive development (Rosińska, 2023).

Crucially, asynchronous e-learning relies heavily on high-quality instructional design and robust IT infrastructure (Muchals et al., 2023). As Khan (2005) notes, "asynchronous learning refers to instruction that is not constrained by geography or time." This lack of real-time interaction, facilitated by digital technologies, grants students unprecedented temporal and spatial flexibility, thereby promoting self-paced learning and deeper cognitive reflection (Driskell et al., 2018; Iwan, 2025). Ultimately, investing in student competencies through these adaptable educational frameworks enhances subsequent labor market efficacy. However, the efficacy of this knowledge transfer is heavily mediated by participant motivation and engagement, with empirical evidence identifying internal motivation as the strongest predictor of the quality of information acquisition. Finally, the shift toward asynchronous methodologies is not merely a reactionary vestige of the pandemic; it reflects a paradigm shift driven by the evolving expectations of contemporary learners who demand digitized, flexible, and autonomous learning environments, while simultaneously catalyzing the digital skills development of both students and educators (Driskell et al., 2018; Iwan, 2025).The results of a study by Omirzak et.al. demonstrated that mobile technologies embedded in new intelligent pedagogy can change the way people consider engineering education. Education without direct teacher supervision is an excellent extension of traditional methods. It doesn't replace personal contact with a mentor, but it works well as a tool for conveying specific facts, methodologies, and various ways of interpreting material.

The progress and outcomes of asynchronous learning depend much more on the student and their attitude than in the case of teacher-assisted learning. However, these types of courses require significantly greater self-discipline and motivation from students.

Remote learning, especially asynchronous learning, can be conducted on the Moodle platform (Modular Object-Oriented Dynamic Learning Environment). This is a globally recognized open-source learning management system (LMS). The platform's long-term development, driven by an international community of experts and enthusiasts, has resulted in a rich ecosystem of extensions and integrations that significantly increase its functional potential. However, it is important to remember that maintaining motivation can be a challenge for students who lack self-motivation and independence, which can lead to lower success rates in online courses (Rawashdeh et al., 2021).

3. Research Methodology

The empirical study was executed during the second half of 2025 utilizing a diagnostic survey design operationalized through a highly structured online questionnaire. The primary research sample initially comprised 280 students enrolled at the Częstochowa University of Technology. Following the distribution of the digital questionnaire link via institutional electronic mail, a rigorous data cleaning process was applied. Consequently, any responses that were partially completed, exhibited logical inconsistencies, or contained ambiguous data were systematically excluded from the dataset. This filtering process resulted in 263 fully qualified questionnaires retained for subsequent statistical analysis—a sample size and response validity rate deemed highly acceptable and representative according to the methodological frameworks established by Sekaran and Bougie (2019).

To ensure the validity and contextual relevance of the findings, a purposive sampling strategy was employed. This approach was essential to deliberately select respondents who possessed direct, practical experience with the Moodle learning management system within the specific organizational framework of the Faculty of Management at the Częstochowa University of Technology. By targeting this specific cohort, the study captured the perspectives of stakeholders directly immersed in the asynchronous learning process, thereby significantly enhancing the applied value and institutional utility of the resulting conclusions.

The targeted respondents consisted of first-cycle students pursuing either a Bachelor of Arts/Science or a Bachelor of Engineering degree. The sample spanned four distinct academic fields: Logistics, Engineering Logistics, Business Finance and Accounting, and Management. In strict adherence to ethical research standards,

the study was conducted under complete anonymity; participants were not required to disclose personal identifying information, and data collection was restricted to macro-demographic variables, specifically age, academic year, and faculty affiliation. Furthermore, prior to engaging with the instrument, all participants provided their informed consent. This was preceded by a comprehensive briefing detailing the overarching objectives of the research, as well as the explicit protocols governing data collection, privacy protection, and processing methodologies.

The author developed the questionnaire based on a review of existing literature and previous research in this area (Stecuła and Wolniak, 2022; Piersiala, 2025). In this article, the adopted goal was tested using a proprietary research tool – a survey questionnaire. It consists of two parts – a metric characterizing the respondents and questions testing the adopted goal of the work. The questionnaire consists primarily of questions or statements that the respondent is asked to rate on a 5-point scale. The questionnaire also includes questions that do not require evaluation, but only a specific response. A five-point Likert scale was employed in the research to assess satisfaction, the availability of materials, and the technical quality of the courses. the survey used a five-point Likert scale, expressed numerically (questions numbered 1-5) with verbal terms describing the extremes of the scale. Respondents were asked to indicate to what extent they agreed with a given statement in relation to the above-mentioned number of questions, having the following response options and their verbal descriptions to choose from: 1 - disagree, (2 - rather disagree, 3 - neither agree nor disagree, 4 - rather agree), 5 - agree). A 5-point Likert scale with a midpoint ("neither agree nor disagree") was chosen because respondents should be able to choose the middle (neutral) option when they have no opinion on a given topic. It was assumed that a 5-point rating scale provided sufficient options and, importantly, was easily understood by respondents. In order to assess the reliability of the questionnaire, Cronbach's alpha coefficient was calculated for the entire survey, obtaining a value of 0.748, which indicates an acceptable level of internal consistency in all sections. It was not limited to verbal descriptions of values, which would raise doubts about the level of measurement. Calculations were performed using SPSS version 29. Descriptive statistics were used to summarize participant characteristics and responses, and categorical variables were presented using frequencies and percentages.

4. Results

The characteristics of the survey respondents were analyzed based on the results of the metrics section of the survey concerning the characteristics of the surveyed students. In total, 263 participants were involved in the study. The study group consisted of women (46%) and men (54%). The largest group was comprised of individuals aged 21-25 (almost half of all surveyed individuals), while every third student was aged 17-20. The largest group of respondents were students majoring in logistics and logistics engineering. The second group consisted of students majoring in finance and accounting in business. The smallest group were students majoring in management. A detailed demographic profile of the sample is presented in Table 1.

Table 1: Participants' demographic characteristics

Variable	*Category*	*N*	*%*
Gender	Women	123	47%
	Men	138	52%
	No data	2	1%
Age	17-20 years	89	34%
	21-25 years	130	49%
	over 25 years	44	17%
Level of education	Bachelor degree	125	48%
	Engineering degree	138	52%
Major of study	Logistics Bachelor's Degree	86	33%
	Logistics Engineering	77	29%
	Business Finance and Accounting	58	22%
	Management	42	16%

First, respondents were asked about their range of digital competencies. Description of response categories for the question "How do you assess your digital competencies related to distance learning?" on a scale from "very poor" to "very good" (Piersiala, 2025):

1. Very Poor: The participant feels their digital competencies in the context of distance learning are very low, experiencing difficulties with educational tools, e-learning platforms, online communication, or other related technologies.
2. Poor: The participant rates their digital skills as low, managing basic functions but lacking confidence in using advanced features, possibly requiring additional support or training.
3. Neutral: The participant is unsure about their digital competencies, possibly due to limited experience with online learning.
4. Good: The participant feels competent in using educational tools, e-learning platforms, and managing digital learning materials effectively.
5. Very Good: The participant possesses high digital skills, efficiently using advanced features of educational technologies and managing their learning process innovatively.

The vast majority of respondents (over 74%) rate their digital competences as good or very good. This demonstrates the high level of technological preparation of students at the Faculty of Management at the Częstochowa University of Technology for asynchronous learning. The low percentage of negative responses (below 9% combined for "poor" and "very poor") suggests that the participants are knowledgeable internet users and can navigate the world of technology.

The next research questions focused on the study and barriers to asynchronous learning, classifying them according to psychological, organizational, social, and technical attributes. The analysis noted that respondents perceived benefits in terms of time and space (mean 4.53), which allows for combining studies with work, but this also requires management permissions. The device provides access to a barrier in the form of a lack of wireless connection to peers and lecturers (mean 3.74), which is considered a major drawback of this educational format, leading to a shift to electronic learning and a weakening of ties with the academic community. Asynchronous education requires students to demonstrate self-discipline, as the lack of rigid time frames and external stimuli, such as face-to-face meetings, can hinder the process of mobilizing independent work. Importantly, technical barriers were no longer available in the event of a problem (mean 1.91), which directly corresponds to the high level of confidential access declared by the study group.

Table 2: Challenges in Distance Learning

Variety	Mean	Deviation	Coefficient of Variation V	Standard Error
Availability of educational materials	4,53	0,77	17,00%	0,047
Working from home	4,36	0,9	20,60%	0,055
Lack of direct contact with peers	3,74	1,16	31,00%	0,071
Time management	3,51	1,14	32,50%	0,07
Motivation for independent learning	3,41	1,17	34,30%	0,072
Maintaining concentration	3,22	1,18	36,60%	0,073
Difficulty separating study/relax	3,06	1,21	39,50%	0,075
Limited contact with lecturers	2,92	1,2	41,10%	0,074
Feeling overwhelmed	2,68	1,18	44,00%	0,073
Difficulty assessing progress	2,46	1,11	45,10%	0,068
Technical difficulties	1,91	1,04	54,50%	0,064

The next research questions focused on the challenges and barriers to asynchronous learning. Factors were classified according to psychological, organizational, social, and technical attributes. In the study group, the highest arithmetic mean values were recorded in areas such as availability of educational materials and working from home. Low standard deviation values in these categories indicate a high degree of homogeneity among respondents' opinions. The analysis revealed that respondents rated the availability of educational materials the

highest (mean = 4.53), which facilitates balancing academic responsibilities with professional commitments and allows for the utilization of learning resources in accordance with the tenets of asynchronous instruction—namely, learning unrestricted by temporal or spatial constraints. Conversely, the lack of direct peer interaction was identified as a prominent barrier (mean = 3.74). This isolation is considered a major drawback of this educational modality, as the transition toward predominantly digitized learning environments tends to attenuate social cohesion and weaken ties within the academic community.

Asynchronous learning requires self-discipline from students, as the lack of rigid time frames and external stimuli, such as face-to-face meetings, can hinder the process of mobilizing students to work independently. Importantly, technical barriers were no longer cited as a significant problem (mean 1.91), which directly corresponds to the high level of confidential access declared by the research group. Analyzing the motivation for independent learning variable, a high standard deviation relative to the mean indicates significant polarization of attitudes within the group, suggesting that individual factors strongly differentiate respondents' experiences in this regard. The coefficient of variation was then applied, which allowed for the assessment of the intensity of the phenomenon under study and the precision of the mean as a representative measure. This indicator allows for assessing whether the research group is consistent in its views. Weak variability (V<20%) occurs only in the availability of materials (V=17.0%), suggesting a uniform distribution of responses. Strong variability (V>40%) was demonstrated in categories such as technical difficulties (V=54.5%) and difficulty assessing progress (V=45.1%). The arithmetic mean has low information value. This is due to the wide distribution of responses and the highly individualized nature of the phenomenon. The standard error of the mean, oscillating between 0.06 and 0.07, indicates high measurement precision resulting from the sample size (n=263). Interval estimation was also performed (for a confidence level of $1-\alpha=0.95$). This allows us to assume that the actual population mean for key parameters falls within the limits of $\bar{x} \pm 1.96 \cdot SEM$. Analyzing the time management variable, the confidence interval is [3.37;3.65]. Such a narrow range confirms that the obtained results are statistically stable and can be used to draw conclusions about the broader population. The high dispersion of results in the area of technical difficulties (V>50%) suggests the occurrence of the so-called "point exclusion" – a small subgroup of respondents with extremely negative experiences whose problems are masked by a low overall average.

Next, the correlation between the variables was examined. The study revealed a strong positive correlation between time management difficulties and difficulty maintaining concentration (r = 0.71). This result suggests that the effectiveness of asynchronous learning on the Moodle platform is determined not so much by the quality of the materials themselves, but by the students' individual self-organizational skills. Furthermore, the moderate relationship between lack of direct contact with peers and feelings of being overwhelmed indicates the need to implement social media tools (e.g., discussion forums, chats) within asynchronous courses to reduce the study group's sense of isolation.

Next, the questions were asked: How user-friendly is the online learning platform and How would you rate the clarity and quality of narration in online learning materials (recorded lectures, videos, etc.)? Most participants expressed positive opinions about various aspects of online learning. Interestingly, 76% found the online learning platform user-friendly. Over 66% of users rated the quality and usefulness of the training materials as “Excellent” or “Good”, indicating their satisfaction with the learning materials (Table 3).

Table 3: Ratings

Questions	N	%
How user-friendly do you find the online learning platform?		
Very user-friendly	126	48
Somewhat user-friendly	75	29
Neutral	30	11
Somewhat difficult to use	24	9
Very difficult to use	8	3
How would you rate the clarity and quality of narration in online learning materials (recorded lectures, videos, etc.)?		
Excellent	115	44
Good	62	24

Questions	N	%
Average	50	19
Poor	28	11
Very poor	8	3

The results obtained demonstrate the great care taken in preparing digital resources by the teaching staff. Over two-thirds of users (66%) declare satisfaction with the quality and usefulness of the training materials, confirming their high substantive value in the educational process. Only a small percentage of students (12%) reported difficulty using the platform, and only 3% found it "very difficult to use." This suggests the need for spot technical support for a small group of users, rather than a complete system overhaul.

5. Conclusions

In addition, mobile technologies in education help to improve technical and communication skills, find answers to the questions of interest, develop the ability to cooperate with other people, allow learners to share knowledge, and, as a result, get better academic results. Students benefit from the opportunity to learn in a self-paced environment where they have control over their pace of learning, information flow, choice of learning activities and time management.

A key finding derived from the research indicates that merely making educational materials or an entire course available on an e-learning platform, such as Moodle, constitutes a mere prerequisite and is far from sufficient for achieving the intended learning outcomes. Indeed, the success of the didactic process within a digital environment requires a synergy between students' advanced information literacy encompassing the ability to independently locate and evaluate reliable scholarly sources and a well-developed capacity for critical thinking and in-depth textual analysis. Furthermore, the autonomous intrinsic motivation of the learner remains a crucial driving force, without which digital tools become nothing more than passive data repositories. Consequently, the absence of these cognitive skills and engagement means that the technologization of education may lead to the phenomenon of superficial knowledge acquisition rather than stimulating genuine intellectual development.

Due to the fact that only 263 people participated in the study, its results cannot be considered universal. To obtain more accurate data, a larger number of participants is necessary. It should also be noted that the study involved students from the Częstochowa University of Technology, so the results may not be applicable to other countries. The study results can be considered reliable, but the above information should be taken into account. Although the sampling approach does not ensure full statistical representativeness and limits the generalizability of results to the broader population of enterprises, it allows for an in-depth exploration of relational patterns between variables within a relevant organizational context. The study is therefore positioned as explanatory rather than strictly generalizable

The evolution of e-learning is inextricably linked to the advancement of digital technologies. Key megatrends such as artificial intelligence (AI), augmented reality (AR), and big data analytics have the potential to fundamentally transform digital teaching. Generation Alpha (born between 2010 and 2025) plays a special role in this process, for whom interactive environments constitute a natural learning space. The synergy of algorithms personalizing learning paths with advanced AR simulations allows for a radical increase in knowledge retention and student engagement (Marciniak, 2022).

Ethics declaration: Ethical clearance was not required for the research

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