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Philosophy of education in a changing digital environment: an epistemological scope of the problem

Raigul Salimova[1] · Jamilya Nurmanbetova[1] · Maira Kozhamzharova[2] · Mira Manassova[3] · Saltanat Aubakirova[2]

Abstract

The relevance of this study's topic is supported by the argument that a philosophical understanding of the fundamental concepts of epistemology as they pertain to the educational process is crucial as the educational setting becomes increasingly digitalised. This paper aims to explore the epistemological component of the philosophy of learning in light of the educational process digitalisation. The research comprised a sample of 462 university students from Kazakhstan, with 227 participants assigned to the experimental and 235 to the control groups. The research employed a scientific methodology that encompassed various scientific methods, including sociological, socio-philosophical, and culturological analysis. In addition, philosophical methods such as system analysis, structural and functional analysis, and comparative and hermeneutical approaches were utilised for the philosophical and epistemological interpretation of the cognitive activity mechanism of students and its dynamics in light of digitalising education. Furthermore, psychological diagnostic methods such as SAMOAL personality self-actualisation diagnostics, personality volitional potential diagnostics, and psychodiagnostic methods were employed. This study offers a theoretical rationale for the integration of digital technology in the realm of education, grounded in philosophical and epistemological principles. In addition, it challenges the null hypothesis that the philosophical and epistemological framework of the educational process does not influence its cognitive and personal aspects. Digital learning has been found to improve both cognitive and personal aspects of the learning process. All indicators of self-realization increased statistically significantly ($p < 0.05$), including cognitive needs (from 9.2 ± 0.1 to 12.3 ± 0.5 points), creativity (from 5.8 ± 0.4 to 10.8 ± 0.4 points), autosympathy (from 6.2 ± 0.1 to 10.8 ± 0.4 points). 8.2 ± 0.3 points). Training in digital technologies improved the willpower of students' personality, the structure of cognitive activity and logical thinking (6.3 ± 0.4 and 7.0 ± 0.5 points, $p > 0.05$). The positive impact of digital technologies on increasing the communicative competence of students can be considered as a factor in mitigating epistemic risks in the learning process. The findings can be used to avoid epistemological risks and improve learning effectiveness in a digital learning environment. There are plans to investigate the gender dimension of digital learning epistemology in the future.

Keywords Cognition · Digital technology · Epistemology · Learning · Philosophy of education

1 Introduction

The current educational reform movement in the twenty-first century is centred around digitalisation and STEM education, which encompasses science, technology, engineering, mathematics, and arts (Li et al. 2020). However, this movement has also brought about an epistemological crisis that undervalues the significance and worth of the humanities and social sciences (Doidge et al. 2020). According to Khandelwal et al. (2020), the cultivation of personal skills within a dynamic educational setting is a crucial factor in achieving success within the contemporary labour market. According to Al-Ababneh (2020), the relationship between

✉ Saltanat Aubakirova
   s.aubakirova@rambler.ru

1   Department of Philosophy, L.N. Gumilyov, Eurasian National University, Astana, Republic of Kazakhstan

2   Department of Philosophy and Social Sciences, Toraighyrov University, Lomov Str., 64, Pavlodar 140008, Republic of Kazakhstan

3   Department of Philosophy and Theory of Culture, Karaganda University of the Name of Academician E. A. Buketov, Karaganda, Republic of Kazakhstan

epistemology, ontology, and research methodology makes it possible to understand the philosophy underlying the research process. It also makes it possible to select appropriate research strategies, define appropriate methods, and construct appropriate research designs.

Today's philosophy of education is predominately a philosophy of learning technologies, with augmented reality philosophy representing one of its most promising directions (Turner 2022). Focusing on the development of digital technologies in the global educational space as a way to solve epistemological problems (Doidge et al. 2020) helps to digitalise epistemological practices. In this context, there is a growing perception of virtual learning environments as an epistemological threat. Due to this, it is important to consider the philosophical underpinnings of virtual learning environments, as well as the ethical and epistemological problems that arise when virtual reality and the real world collide (Turner 2022).

Hence, the significance of digitalising education epistemological aspects has made the subject pertinent, driven by the requirement to examine how the educational process has changed in a digital environment from the standpoint of educational philosophy.

The study's theoretical justification of the education digitalising process from a philosophical and epistemological standpoint constitutes its *scientific novelty*.

The research findings have *practical value* because they could be used to prevent epistemological risks and improve how well people learn in a digital learning environment.

2 Literature review

2.1 Philosophical foundations of the educational process

The relationship between philosophy and scientific knowledge is a contentious issue (De Caro and Macarthur 2022). It is common knowledge that philosophical issues are much broader than those of individual natural science disciplines (De Caro and Macarthur 2022).

The COVID-19 pandemic, which is viewed as a crisis of traditional education, has led to a rethinking of the conceptual underpinnings of the educational process in relation to its digitalisation and shift to distance learning, according to philosophical theories of education (Dege and Strasser 2021).

Philosophical, pedagogical, and historical considerations are critical for computer science and digital learning technologies to advance (Lodi 2020). In this context, scientific problems in education are raised that require quantitative, qualitative research and historical–philosophical argumentation, such as: the relationship between theories and practical

approaches to learning; cognitive aspects of digitalization of the educational process and computer literacy of teachers and students; and the affective–motivational component of understanding intelligence and ability (Lodi 2020). Educational philosophy's future is linked to epistemology's ethico-ontological aspects (Tesar et al. 2022).

2.2 Digitalisation of the learning environment

Immateriality and virtuality characterise the digital environment (Taffel 2019). Chaos theory, which mathematically describes the behaviour of nonlinear dynamical systems, implies that their behaviour is dependent on initial conditions, and that even minor changes in the environment can have unpredictable consequences. The philosophy of competencies in digital information educational environments is analysed in relation to the chaos theory of disciplines in social sciences (Lund and Aagaard 2020). This analysis is guided by the calculation of a competency index, which serves to determine the evolution of disciplines as they undergo digital transformation (Raju 2020).

According to Makhachashvili (2022), the integrative nature of the educational domain of information and communication is attributed to its transdisciplinary and innovative communication practices within educational communities. This unity is evident at both macro and micro levels, and offers a holistic approach to addressing existential, cognitive, anthropological, and technological challenges.

More use of digital technologies in education is seen as a way to make sure that teaching is effective and to deal with issues of educational equity (Balg 2022). The use of digital resources aims to improve educational quality by increasing student engagement and ensuring productive interaction between people and digital technologies while taking the epistemological and ethical dimensions of this process into account (Aagaard and Lund 2019).

Human civilisation's technological impact on the environment has resulted in significant and irreversible changes, known as the Anthropocene epoch (Fagan 2019). Contemporary researchers tend to interpret higher education reforms through the philosophical lens of the problem of anthropocene survival in its broadest sense, encompassing environmental issues, the dynamics of global economic markets, migration processes, existential quests, and the ambiguity of scientific progress (Keenan 2020). Many researchers contend that academic curricula should be reshaped based on transnationalism and transdisciplinarity with a focus on present practical challenges to meet the educational needs of these contexts (Keenan 2020). Other scholars (Payne 2019) tend to call the present time 'post-anthropocene', with an epistemological view of knowledge production as 'performative abstractionism' with new structural–logical and intellectual features on a global scale.

Students' capacity for self-organisation, activity, and autonomy have emerged as crucial features of distance learning programmes in the wake of the COVID-19 pandemic (Rapanta et al. 2021). In addition to digitalisation, higher education will likely move in a more pedagogical direction in the future, combining physical and digital learning methods in a way that ensures the learning process's logic, adaptability, and activity (Rapanta et al. 2021).

2.3 An epistemological approach to digital learning

The pursuit of knowledge that is authentic, relevant, and valid (David et al. 2023) can be seen in the effort to ensure epistemological access by all actors in the educational process. The theory of mathematical workspaces seeks to combine an epistemological and a cognitive approach to education. In this theory, the epistemological approach defines the nature of mathematical activity, and dialectical philosophy explains its connection to communicative processes (Kuzniak and Vivier 2019).

A transdisciplinary synthesis of philosophical, communicative, information theories, humanities, and e-learning provides epistemological acquisition of new knowledge in a digital environment (Makhachashvili 2022). Multiple conceptual approaches to learning, a multilingual educational environment, and philosophical foundations for scientific activity all contribute to the epistemic diversity of people's understanding of the world (Gobbo and Russo 2020). One of these is the epistemological concept of literacy, which describes how people can use their own free will to digitally change the world around them, manage information flows, and use them in a smart and ethical way (Tedre et al. 2020).

2.4 Epistemological challenges of digitalising education

One of the epistemological problems of using social networks for educational purposes is the spread of fakes in the form of viral content, which determines the importance of developing critical thinking as a key competency of modern education (Alfano and Klein 2019; Koliadenko 2022). Researchers have noted that there are individual differences in social epistemological predispositions related to age, defined by a simple psychometric scale and manifested by people's varying willingness to accept and share fake information (Alfano and Klein 2019). Thus, increased knowledge through social media is associated with epistemic dangers, the prevention of which can be ensured through a philosophical model of safe trust in human interaction with artificial intelligence (Alfano and Klein 2019; Ferrario et al. 2020).

From a philosophical standpoint, the process of digitalization is viewed as a means to achieve a post-digital future.

This future entails the development of 'post-digital humans' who possess a distinct post-digital mindset that pertains to the three fundamental aspects of humanity: life, consciousness, and behaviour. These individuals are capable of existing in various forms, whether carbon-based or not, thereby blurring the distinction between humans and biomachines (Jandrić 2021). This pathway can be interpreted as a form of epistemological risk that arises from the necessity of making decisions amidst growing uncertainty, as noted by Ardashkin (2014). This emphasises the dialectical nature of the educational process's digitalisation.

The Internet's digital information and communication environment has become an important part of modern life. However, virtual space poses risks and negative consequences for users in terms of human autonomy, aggression, political extremism, and fake information. Hence, one of the current research areas focuses on enhancing digital literacy, cognitive abilities, and the capacity to withstand manipulation to ensure psychological control over the digital environment (Kozyreva et al. 2020).

The issue of digital phenotyping, which is the evaluation of human personality through personal digital devices, is of interest in terms of the epistemological, methodological, and ethical aspects of digital technologies. To address the issue, philosophical approaches are being developed to determine the epistemological relationships between human psychobehavioural characteristics and the information coming from digital devices (Coghlan and D'Alfonso 2021).

2.5 Problem statement

Students' academic performance revolves directly around the quality of teaching, which depends on epistemological access to higher education, its adaptability and accessibility in distance learning, by balancing learning and other activities (David et al. 2023).

The philosophical context of the problem is intertwined with education epistemology, which also encompasses ethical dimensions. This connection determines the objectives and goals of learning, teacher and student values and motivations, and other interpersonal dynamics among those involved in the educational process (Buchanan et al. 2022).

Matthews et al. (2021) argue that the educational process within a dynamic digital environment encompasses a philosophical dimension that involves fostering competencies that empower individuals to adapt and exercise independent judgement in situations characterised by ambiguity, which are characteristic of the fourth industrial era. The UN Sustainable Development Goals and their implementation guidelines based on the achievement of social and epistemic justice and equity are the context in which the philosophical and epistemological aspects of digitalising education are implemented (Burke et al. 2023).

The study *aims* to investigate the epistemological aspect of learning within the framework of the educational process digitalisation. This is motivated by the importance of an epistemological approach in understanding the philosophical underpinnings of digital transformation processes in education.

The research objectives involved answering the following research questions:

Q1. To what extent is education epistemology in the digital environment presented in the academic literature?

Q2. What impact does digitalising education have on the educational process epistemology?

Q3. Can educational philosophy in a dynamic digital environment help to prevent epistemological risks and enhance learning?

The hypothesis was based on the assumption that approaching the educational process from a philosophical and epistemological standpoint has no significant impact on the cognitive and personal components of the educational process. It is a null hypothesis, implying that there is no philosophical–epistemological link between the digitalisation process and the cognitive–personal aspects of learning.

3 Materials and methods

The study was designed to be completed in stages. The first stage involved determining the relevance of the research topic, analysing scientific literature on digitalising education epistemology, defining the problem, and formulating the study's purpose and objectives. The second stage involved defining the research methods and materials, choosing reliable psychodiagnostic techniques for the experiment, and respondent sampling. The third stage included experimental research, statistical processing, and results analysis. The fourth and final phase of the study consisted of drawing conclusions and identifying future research opportunities.

The research methodology was founded on a philosophical and epistemological understanding of the cognitive process and how the systems theory and dialectical philosophical teaching interpret it, as well as a philosophical and epistemological approach to the study of knowledge and the value component of human cognitive activity (Ilyin 2010). The educational process was viewed through the lens of an epistemological approach within the framework of the problem under study, which entails studying the mechanisms of students' cognitive activity and how digitalisation transforms it. The epistemological approach to education is associated with a philosophical metaphysical basis and determines the choice of object, subject and methods of research, as well as the interpretation of the resulting research results (Gabriel 2023). The study's scientific methodology included both general scientific methods of sociological, socio-philosophical,

and cultural analysis, as well as psychodiagnostic techniques that assisted in identifying philosophical and epistemological features of the dynamics of students' cognitive activity in digitalising education. Furthermore, the study employed philosophical methods of systemic, structural, and functional analysis, as well as comparative and hermeneutic approaches (Kolesnikov 2008) to provide a philosophical and epistemological analysis of the dynamics and mechanisms behind students' cognitive activity in digitalising education. The epistemological approach to education is associated with a philosophical metaphysical basis and determines the choice of object, subject and research methods, as well as the interpretation of the research results.

The study intended to explore the process of students' knowledge acquisition in a digital learning environment from a philosophical and epistemological standpoint. The experiment lasted for the second academic term of the academic year 2021/22. The sample of respondents was drawn at random from a pool of university students in Kazakhstan. The experimental group consisted of 227 students (119 males and 108 females, mean age 20.1 years) taught using digital technology. The control group consisted of 235 students (125 males and 110 females with a mean age of 19.9 years) taught using traditional methods without digital technology. In this case, the age group consisting only of 2nd year students was considered as a valid indicator for the results obtained and conclusions in the article. Age group, period of study and cultural characteristics can be considered as significant factors that can influence the results of the study and determine the corresponding conclusions. Of scientific interest is the influence of the digitalization process on epistemology in its relationship with the concept of "situated knowledge" that determines the methodological approach to conducting research (Montenegro et al. 2023). Google Forms customised for each testing method were used to administer the tests.

Since education philosophy includes interdisciplinary methods, the psychodiagnostic methods listed below were used to determine the specifics of knowledge acquisition in the digital environment (http://testoteka.narod.ru/alfavit.html):

– The Personality Self-Actualisation Diagnostic (SAMOAL technique developed by A.V. Lazukin and adapted by N. F. Kalin) technique for studying the peculiarities of a person's sense of life and value orientations. The method consists of a 100-item questionnaire in which respondents' levels of *Time Orientation, Values, Human Nature Insights, Need for Knowledge, Creativity, Autonomy, Spontaneity, Self-Understanding, Autosympathy, Contactivity,* and *Communication Adaptability* abilities are measured. The maximum score on each scale is 15 points (100%).

- The 15-item Personality Willpower Diagnostics questionnaire to measure the respondent's level of willpower (1–12 points for low level, 13–21 points for medium level, and 22–30 points for high level).
- The 56-item Diagnostics of the Signal Systems Structure questionnaire (Zeer et al. 2004) with the results presented as a graph showing the respondents' levels of the following signal system characteristics: *Metaphorisation, Imagery, Symbolisation, Verbalisation, Abstraction, Reflexivity,* and *Manual Skills*. Indicators on these scales can have a minimum value of 2 and a maximum value of 8 (Zeer et al. 2004).
- The Logical Reasoning questionnaire to assess logical thinking by determining the formal correctness of 12 logical inferences from a set of statements (3–6 points for low level, 7–10 points for acceptable level, 11–12 points for high level) (Kasyanov 2006).
- A Thinking Quickness Study Method consisting of 40 test tasks (composing words from separate letters and syllables by inserting missing letters) to assess orienting and operative components of the thinking process (less than 20 words out of 40 for low thinking quickness and mental agility, 21–30 words for medium, and 31 or more words for high).
- A Working Memory Examination Method based on the search for a correspondence of geometrical figures to assess respondents' working memory (1 point for very low level, 2–3 points for low level, 4–6 points for medium level, 7–8 points for high level, and 9 points for very high level) (Pavlyutenkov 1990).
- The MIS Self-Esteem Research Method (S. R. Panteleev) using a questionnaire of 110 questions and 9 scales (*Closeness, Self-Confidence, Self-Management, Reflected Self-Esteem, Self-Value, Self-Acceptance, Self-Attachment, Internal Conflict,* and *Self-Blaming*) to

evaluate the structure and identify individual components of one's self-esteem (1–3 points for low level, 407 points for medium level, and 8–10 points for high level) (Posokhova and Solvieva 2008).

The results were statistically processed using Microsoft Exel software, which gathered, sorted, analysed, and visualised the data. The Social Science Statistics online calculator was used to calculate the *t* value (Student's *t* test) required to assess the statistical validity and significance of the results and to identify the relationship between the test scores using the Pearson correlation coefficient rxy.

4 Results

From a philosophical and epistemological point of view, personal self-actualisation is the need for a person to find and reach their full potential. Drawing from the perspective that learning is a process of acquiring knowledge and competencies with the goal of implementing personal value orientations within the context of said orientations, this study examined the self-actualisation indicators of participants in the learning process. Specifically, the study compared the dynamics of self-actualisation indicators between a group that utilised digital learning technologies (experimental group) and a group that did not (control group), as presented in Table 1.

The table indicates that the self-actualisation scores of the participants in the experimental and control groups were similar in the primary study, with no statistically significant difference ($p > 0.05$). Moreover, the scores fell within the average range. In the follow-up study, both groups exhibited a marginal rise in the self-actualisation indicators across all scales. However, the changes observed in the group that

Table 1 SAMOAL Results for the Changes in Personal Values and Attitudes During the Study in the Experimental Group (A—primary study, A1—follow-up study) and the Control Group (B—primary study, B1—follow-up study)

Scale	GPA		Student's *t* test	p	GPA		Student's *t* test	p
	A	A1			B	B1		
Time orientation	6.1±0.3	7.8±0.2	− 8.17	<0.05	6.2±0.1	6.4±0.2	− 1.55	>0.05
Values	6.9±0.1	8.4±0.3	− 8.22	<0.05	6.8±0.4	7.2±0.3	− 1.39	>0.05
Human nature insights	6.5±0.2	9.2±0.1	− 20.91	<0.05	6.5±0.3	6.8±0.2	− 1.44	>0.05
Need for knowledge	7.1±0.3	12.3±0.5	− 15.35	<0.05	7.0±0.4	7.5±0.2	− 1.94	>0.05
Creativity	5.8±0.4	10.8±0.4	− 15.31	<0.05	5.9±0.2	6.4±0.5	− 1.61	>0.05
Autonomy	6.3±0.2	8.1±0.3	− 8.65	<0.05	6.1±0.4	6.8±0.5	− 1.89	>0.05
Spontaneity	5.9±0.3	8.0±0.4	− 7.92	<0.05	6.0±0.2	6.2±0.1	− 1.55	>0.05
Self-understanding	5.5±0.2	7.6±0.5	− 6.75	<0.05	5.4±0.3	5.7±0.1	− 1.65	>0.05
Autosympathy	6.2±0.1	8.2±0.3	− 10.95	<0.05	6.3±0.2	6.5±0.2	− 1.22	>0.05
Contactivity	6.9±0.4	8.5±0.4	− 4.99	<0.05	6.8±0.5	7.1±0.1	− 1.53	>0.05
Communication Adaptability	5.7±0.5	7.4±0.2	− 5.47	<0.05	5.8±0.3	6.1±0.2	− 1.44	>0.05

underwent traditional training procedures without digital technology were not statistically significant ($p > p > 0.05$).

In the experimental group, on the contrary, the increase in all self-actualisation indicators was reliable and statistically significant ($p < 0.05$). There was a particularly marked increase in the self-actualisation indices on *Human Nature Insights* (from 6.5 ± 0.2 to 9.2 ± 0.1 points), *Need for Knowledge* (from 9.2 ± 0.1 to 12.3 ± 0.5 points), *Creativity* (from 5.8 ± 0.4 to 10.8 ± 0.4 points), and *Autosympathy* (from 6.2 ± 0.1 to 8.2 ± 0.3 points) scales.

The epistemological perspective on education emphasises the cognitive process's reliance on personal qualities, the most important of which is willpower, which ensures students' motivational orientation is implemented. Table 2 displays the results of the personality willpower study for the experimental and control groups of respondents.

The personality willpower indicators in the experimental and control groups did not statistically differ ($p > 0.05$) and were within the average values in the primary study. The change in students' personality willpower capacity in the control group trained during the experiment using traditional methods without digital technology was statistically insignificant ($p > 0.05$) in the follow-up study. In the experimental group trained with digital technology, personality willpower indicators during the follow-up study (< 0.05 points) were statistically significantly and significantly different from the initial value (15.2 ± 0.4 points), reaching the low end of the range of high values for the indicator.

The psychophysiological characteristics of human cognitive activity play a significant role in how it is organised in a philosophical and epistemological context. The study results concerning the dynamics of signalling system development indicators among students in the experimental group trained using digital technology and the control group trained without digital technology are shown graphically in Fig. 1.

The graph shows that the control group's scores in the follow-up study are nearly identical to those in the primary study. Simultaneously, students in the experimental group demonstrated significantly improved indicators of personality signalling systems.

The philosophical foundations of the educational process place great emphasis on the role of logical thinking in epistemology. This is particularly important in the current era of digital technologies and STEM education, which serves as the philosophical and epistemological basis for innovative educational policies in modern economic conditions. These policies encourage people to learn and use science, technology, engineering, mathematics, and art together. Diagnostics of the structure of signalling systems make it possible to get a full picture of how digital learning affects these parts of STEM education. Thus, metaphorisation refers to one's ability to recognise, invent, and employ metaphors in verbal communication, which is a sign of creative ability. The *Imagery* scale measures the presence of artistic abilities and the extent of imagination and imaginative thinking. Linguistic abilities, the ability to interpret signs and symbols, and the ability to generalise reveal the level of abstract–logical thinking, as measured by the *Symbolisation* and *Abstraction* scales. The *Verbalisation* scale measures verbal proficiency, and the *Reflexivity* scale measures the capacity for deep thought and action analysis. The *Manual Skills* scale assesses technical creativity skills.

Table 2 Personality Willpower Dynamics in the Experimental Group (A—primary study, A1—follow-up study) and the Control Group (B—primary study, B1—follow-up study)

Indicator	GPA		Student's t test	p	GPA		Student's t test	p
	A	A1			B	B1		
Personality willpower capacity	15.2 ± 0.4	21.9 ± 0.5	-18.12	< 0.05	15.1 ± 0.5	15.8 ± 0.3	-2.08	> 0.05

Fig. 1 Dynamics of the Respondents' Personality Signalling Systems Development (red—generalised results of the primary study, yellow—control group results in the follow-up study, green—experimental group results in the follow-up study)
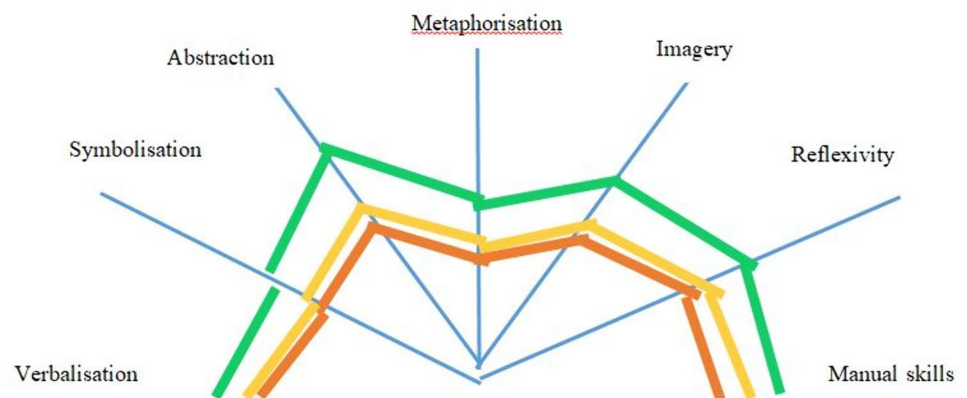
Table 3 compares the dynamics of students in the experimental group who were taught using digital technology and students in the control group who were not. As shown in the table, the initial level of logical abilities of students in both groups was comparable ($p > 0.05$) and within acceptable ranges. Students in the control group had no significant changes in logic thinking (6.3 ± 0.4 and 7.0 ± 0.5 points, $p > 0.05$), whereas students in the experimental group had significant and statistically significant improvements (from 6.2 ± 0.5 to 10.1 ± 0.3 points, $p > 0.05$).

Working memory was also examined when the cognitive component of educational epistemology was assessed (Table 4).

The primary study revealed that working memory was low in both groups of students (3.8 ± 0.3 and 3.8 ± 0.5 points, $p > 0.05$), as shown in the table. The follow-up study revealed that the working memory in the control group trained without digital technology improved slightly, but not statistically significantly (4.2 ± 0.3 points, $p > 0.05$), whereas in the experimental group it improved significantly (to 6.9 ± 0.2 points, p0.05) and reached high levels.

The results shown in Table 5 indicate that a person's self-esteem plays a significant role in determining the success of their educational endeavours.

In the primary study, self-esteem levels in the experimental and control groups were comparable ($p > 0.05$) and ranged between low and average.

In the follow-up study, the self-esteem indicators of the control group had a statistically insignificant ($p > 0.05$) tendency towards positive dynamics, while the self-esteem indicators of the experimental group trained with digital technology had a statistically reliable and significant ($p > 0.05$) tendency towards normalisation on all scales of the method. Particularly significant were the improvements in *Self-Esteem* (from 3.1 ± 0.2 to 8.2 ± 0.1 points), *Self-Acceptance* (from 3.2 ± 0.3 to 8.1 ± 0.3 points) and *Self-Attachment* (from 8.1 ± 0.3 to 4.6 ± 0.2 points).

Table 3 Dynamics of Logical Thinking Indicators in the Experimental Group (A—primary study, A1—follow-up study) and Control Group (B—primary study, B1—follow-up study)

Indicator	GPA		Student's t test	p	GPA		Student's t test	p
	A	A1			B	B1		
Level of logical thinking	6.2 ± 0.5	10.1 ± 0.3	-11.58	<0.05	6.3 ± 0.4	7.0 ± 0.5	-1.89	>0.05

Table 4 Dynamics of Working Memory Improvements in the Experimental Group (A—primary study, A1—follow-up study) and Control Group (B—primary study, B1—follow-up study)

Indicator	GPA		Student's t test	p	GPA		Student's t test	p
	A	A1			B	B1		
Level of working memory development	3.8 ± 0.3	6.9 ± 0.2	-13.86	<0.05	3.8 ± 0.5	4.2 ± 0.3	-1.19	>0.05

Table 5 Dynamics of Self-Esteem in the Experimental Group (A—primary study, A1—follow-up study) and the Control Group (B—primary study, B1—follow-up study)

Scale	GPA		Student's t test	p	GPA		Student's t test	p
	A	A1			B	B1		
Closeness	4.5 ± 0.2	2.9 ± 0.3	7.69	<0.05	4.4 ± 0.2	4.0 ± 0.3	1.92	>0.05
Self-confidence	4.2 ± 0.1	7.1 ± 0.5	-9.85	<0.05	4.2 ± 0.2	4.5 ± 0.3	-1.44	>0.05
Self-management	2.9 ± 0.2	5.8 ± 0.3	-13.93	<0.05	3.0 ± 0.1	3.3 ± 0.2	-2.32	>0.05
Reflected self-esteeem	4.8 ± 0.5	8.0 ± 0.5	-7.84	<0.05	4.8 ± 0.3	5.5 ± 0.4	-2.42	>0.05
Self-value	3.1 ± 0.2	8.2 ± 0.1	-39.50	<0.05	3.3 ± 0.4	4.1 ± 0.5	-2.16	>0.05
Self-acceptance	3.2 ± 0.3	8.1 ± 0.3	-20.00	<0.05	3.4 ± 0.5	4.2 ± 0.4	-2.16	>0.05
Self-attachment	8.5 ± 0.1	4.6 ± 0.2	30.21	<0.05	8.6 ± 0.2	8.1 ± 0.5	1.61	>0.05
Internal conflict	4.4 ± 0.2	2.1 ± 0.6	6.30	<0.05	4.1 ± 0.3	3.6 ± 0.5	1.49	>0.05
Self-blaming	5.8 ± 0.4	3.4 ± 0.1	10.08	<0.05	5.7 ± 0.2	5.2 ± 0.5	1.61	>0.05

5 Discussion

The epistemological foundations of teaching methods are interpreted philosophically in the context of interdisciplinarity, technology, and project-based learning (Purzer et al. 2022). Primarily, the need to ensure the economic competitiveness of educational institutions drives the need for more educational initiatives. However, technological advancements clash with the humanities and social sciences, which erect barriers to uncontrolled experimentation in the form of bioethical and ecological constraints (Bencze et al. 2020). Discussions of the philosophical, ontological, epistemological, and axiological aspects of this issue should be included in the educational process, and students should actively participate in finding solutions to particular real-world socio-scientific problems (Bencze et al. 2020; Hourigan and Edgar 2020). This will help students develop critical thinking as a crucial skill in modern education. The students in the experimental group trained with digital technology and the students in the control group trained without digital technology during the experiment both demonstrated positive dynamics of critical thinking, as measured by the logical thinking test. In addition, a statistically significant ($p < 0.05$) improvement in the scores of students in the experimental group on the *Closeness* scale of the MIS Self-Esteem Research Method provided further support for an increase in critical thinking during digital training. This scale measures a person's ability to reflect, critically evaluate oneself and others, overcome psychological defences, recognise problems, and be willing to solve them. Thus, the study's findings revealed that using digital technology statistically significantly ($p < 0.05$) improves the level of logical and critical thinking, confirming the importance of digitalisation in the educational process.

The epistemological aspect of philosophy of education is closely related to the philosophical and ethical foundations of pedagogy, moral principles and commitments, issues of professional ethics and pedagogy in the interpersonal relations of educational actors (Buchanan et al. 2022). The gender dimension of knowledge structure, which in modern philosophical understanding is seen in terms of feminist theory, is important to mention when discussing the difficulties of digital education (Gurung 2020). This study did not investigate the gender aspect of digitalising education, which is planned for future research.

When dealing with big data, philosophical and epistemological issues must be considered to objectively characterise and theorise the digitalisation process (Balazka and Rodighiero 2020). Models of ecological and social sustainability define human impact on the environment in the Anthropocene era. In this way, science education

has an important role to play in making sure that social change is sustainable and that people interact with the environment in a responsible way (Jeong et al. 2021). In this respect, one's cognitive context is representative of their ability and capacity to engage with their environment in pursuit of self-actualisation, self-discovery, and talent/skill development. The study found that learning with digital technology increases a person's awareness of the existential value of being, as evidenced by an improvement in the *Time Orientation* indicator, as well as harmonisation of relationships with the surrounding world, as evidenced by an increase in scores on the *Values* and *Human Nature Insights* scales.

Science education plays a philosophical and epistemological role in ensuring environmental and social sustainability through responsible human interaction with the natural world (Jeong et al. 2021). Modern education can be seen as an open, democratic, ethical, and participatory process that addresses environmental and sustainability issues when modern cognition is viewed philosophically as a nonlinear process (Reid 2019). This suggests improved imaginative abilities, creativity, and decision-making abilities, which is supported by a statistically significant ($p < 0.05$) rise in the experimental group respondents' indicators on the respective SAMOAL method scales.

Contemporary perspectives on learning, which draw upon behavioural and neuroscience frameworks, approach the topic through a cognitive lens (Cope and Kalantzis 2022a). At the same time, making education more about the individual goes against its social goals (Cope and Kalantzis 2022a). A philosophical approach based on information and communication technologies defines modern education as 'cybersocial', refractive of historically established knowledge systems in an individual context (Cope and Kalantzis 2022b). Significant epistemological implications result from how digitalization is affecting knowledge acquisition in education. This is supported by statistically significant results ($p < 0.05$) indicating an increase in signal system structure, nervous process mobility, thinking rate, and working memory among participants in the experimental group compared to those in the control group.

Within a philosophical framework, the process of learning is conceptualised as a discourse between the tangible, encompassing entities such as objects, physical bodies, historical events, and natural occurrences, and the intangible, which embodies the theoretical, conceptual, and ideological foundation of the educational experience (Cope and Kalantzis 2022b). This study highlights the beneficial effects of digital learning on self-actualisation measures such as spontaneity, self-understanding, and autosympathy. During the process of digital learning, students experience an increase in self-assurance and a greater awareness of the world around them. This leads to heightened motivation

to acquire new knowledge and a greater understanding of their own cognitive requirements, as well as the willpower for attaining desired learning outcomes.

Epistemic vices, which hinder the acquisition of knowledge, are categorised by educational philosophy as negative cognitive factors, including dogmatism and lack of criticality. According to Kidd et al. (2020), various forms of epistemic vices, such as epistemic arrogance and snobbery, epistemic injustice, procrastination, and limiting attitudes, have adverse effects on social life and impede educational progress. The present research demonstrates the epistemological benefits of digitalised learning, as indicated by a statistically significant and reliable ($p < 0.05$) improvement in the Connectivity and Communication Adaptability scores of the SAMOAL method, and the normalised scores on all scales of the MIS Self-Esteem Research Method, among students in the experimental group. Although the correlation was not particularly strong, there was a positive correlation (rxy = 0.25) between the scales of these methods.

As previously mentioned, educational philosophy is closely related to pedagogical psychology, which influences the selection of learning, teaching, and research activities (Cartiff et al. 2021; Flis 2019). The current educational process is influenced by various socio-economic and environmental factors, including crises, climate change, and environmental degradation. The Anthropocene can be defined philosophically as a period of global capitalism and the threat of the extinction of biological life. The increased negative anthropogenic impact on the environment during the globalisation era has been linked to a higher risk of extinction. To address the crisis, a comprehensive re-evaluation of teaching methods from philosophical, epistemological, ethical, ethological, and ontological perspectives is required (Carstens 2019).

The study by Li et al. (2020) highlights the philosophical–epistemological approach as a means of enhancing STEM education. This approach aims to foster critical thinking skills and problem-solving competencies among students, as emphasised by Simarro and Couso (2021).

During the transition to online learning, which encompasses both distance learning and individual learning via networked computers, the traditional models and practices of the educational process are evolving (Cope and Kalantzis 2022b). One of the epistemological aspects of science education is the use of computer modelling for educational purposes, in which an epistemology of models defines the relationship between scientific concepts and the real world (Develaki 2019). To solve the knowledge problem, researchers have turned to an emergent epistemology grounded in pragmatism and systems thinking, which provides an explanation of the philosophy of cognition through the lens of the relationship between the educational process as a whole and its constituent parts (Sallos et al. 2019). The increased

ability of respondents in the experimental group to overcome challenges, find solutions to problems, develop and improve themselves, and manage both external and internal conflicts confirms the philosophical and epistemological advantage of digital learning technologies. This is shown by the fact that all the indicators in the MIS Self-Esteem Research Method have been normalised.

The era following the digital age is defined by the interplay between digital technologies and the biological realm. This is marked by the widespread integration of big data algorithms into various facets of human existence, as well as advancements in biotechnology and genetic engineering, which give rise to ethical concerns (Jandrić 2019). These changes mark the beginning of a new era in the philosophical and epistemological understanding of education. They also show how important digitalisation is for the improvement of human, natural, and social domains.

The limitations were predominantly associated with the experiment's duration. Given the digitalising education setting, it proved challenging to establish comparable conditions for the control group in terms of restricting the use of digital technology during the educational process. This difficulty stemmed from the potential for students to fall behind and for the curricula to become inconsistent. Therefore, the study was only conducted over the course of one academic term, and it only included second-year undergraduate students who were not already involved in research projects or digital technology research, or who were working on master's qualification projects. Furthermore, it was not the intent of this study to make any distinctions based on respondents' gender. This aspect of digitalising education will be investigated further.

5.1 Ethical issues

The ethics committee's approval, the informed consent forms signed by each participant in the study, the results' anonymity, the confidentiality of the participants' personal information, and adherence to all other bioethical guidelines for scientific research were used to ensure that the research process's *ethical considerations* were met.

6 Conclusion

It was found that while there has been increased attention to the philosophical question of the epistemology of digital learning, the practical aspects of the problem and related empirical research have been underrepresented in the scientific literature.

The study revealed that a philosophical–epistemological approach to learning with digital technology contributes to improved students' imagination, creativity,

decision-making skills, self-confidence and openness to the world around them, increased motivation to learn new things and awareness of their own cognitive needs.

It was discovered that digital learning improves both the cognitive and personal aspects of the learning process. All self-actualisation indicators increased statistically significantly ($p < 0.05$), including cognitive demands (from 9.2 ± 0.1 to 12.3 ± 0.5 points), creativity (from 5.8 ± 0.4 to 10.8 ± 0.4 points), and autosympathy (from 6.2 ± 0.1 to 8.2 ± 0.3 points).

Digital technology training improved students' personality willpower, cognitive activity structure, and logical thinking (6.3 ± 0.4 and 7.0 ± 0.5 points, $p > 0.05$).

The positive impact of digital technology on improving the communicative competence of students can be viewed as a factor in mitigating epistemic risks during the training process. This is supported by statistically significant findings ($p < 0.05$) indicating an increase in scores on the *Contactivity* and *Communication Adaptability* scales of the SAMOAL method, as well as normalised scores on all scales of the MIS Self-Esteem Research Method.

The experimental investigation has validated the noteworthy influence of digitising education on its philosophical and epistemological aspects. The study provides a theoretical rationale in favour of digitalising education from a philosophical and epistemological standpoint. In addition, the null hypothesis, which posits that the philosophical and epistemological approach to the educational process has no impact on its cognitive and personal components, is disproven.

Thus, the results of the study show that understanding the philosophical and epistemological foundations of education, having a positive impact on the development of students' communicative competence, can help reduce epistemological risks and thus increase the effectiveness of learning in the digital educational environment.

Availability of data and materials Not applicable.

Declarations

Conflict of interest This research has no conflict of interest.

Ethics approval The authors declare that the work is written with due consideration of ethical standards. The study was conducted in accordance with the ethical principles approved by the Ethics Committee of Toraighyrov University.

Consent to participate Informed consent was signed by participants.

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