Full research paper

A STUDY OF STUDENTS' PREFERENCES IN THE INFORMATION RESOURCES OF THE DIGITAL LEARNING ENVIRONMENT

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ABSTRACT

The digital learning environment comprises various resources - didactically transformed and untransformed information, and mediated communication. Students' information behaviour combines both actions characteristic of the traditional educational process and specific for the digital environment, based on digital tools and user interactions. Students' information behaviour in the digital environment is considered as an indicator of their engagement in various educational activities that contribute to the personalisation of learning. The results of a survey on students' preferences of information resources in the digital environment show that learners use a variety of information sources, but they mainly apply the methods of work in the "traditional" learning paradigm. They insufficiently use the digital environment potential of collaboration, knowledge exchange, and knowledge extraction from authentic sources. Obtained data indicates problems in students' information culture and shortcomings in the methodological support of students' autonomous work. Based on the results, recommendations on creating conditions for developing students' prospective strategies of interaction with digital resources are proposed. These recommendations include a gradual increase of the authentic digital learning resources, an account of students' information preferences, and a particular attention to the management issues in the digital learning environment.

KEYWORDS

Information behaviour, information resources, digital learning environment, information culture, preferences, student

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Highlights

- *Information behaviour reflects a personal information culture.*
- *Students are familiar with the capabilities of digital educational content, but they do not use the entire potential of the digital learning environment - collaboration, knowledge exchange, and knowledge extraction from authentic sources.*
- *Students prefer interactivity and gamification in learning.*

INTRODUCTION

Modern education prepares students for effective activities in the knowledge society, based on the possession of knowledge and the ability to use it. Drucker (2017: 298) emphasised the importance of 'universal skills to use and systematically acquire knowledge as the basis for efficiency, qualifications, and achievements…'. The digital learning environment comprises social experience, scientific knowledge, and educational resources that work efficiently due to the capabilities of multimedia, interactivity, customisation, and productivity. Consequently, methods and technologies of "traditional" education should change to serve students' productivity in the digital learning environment. Educational resources of the progressing digital environment have significant features in comparison with traditional, mainly printed sources of information:

- various information channels in the educational environment;

- variable technologies for organising, storing, and providing students with educational content;
- functional digital resources pedagogical design which contributes to educational process activation and personalisation;
- strengthened role of open educational resources and resources for self-education;
- capabilities of learning content processing with the use of digital tools;
- personalised learning objects.

We need to connect the innovative digital content opportunities to the current knowledge trends in the emerging knowledge society and the long-term demands of the labour market of the digital economy. This problem and the general digitalisation of education objectives are closely interrelated. New meaningful educational goals arise with the influence of changing technological structure, the need to master new digital tools; solve new cognitive problems in the learning process, and further self-development. Constructing a personal evaluative knowledge system, finding personally effective ways to interact with information, and acquiring skills in the digital environment becomes increasingly important for students. Achieving these new goals is impossible without taking into account the individual preferences, opportunities, interests, and initiative of students.

One of the most important educational goals is shaping students' active learning position concerning available information resources. Such a position presumes perception of educational, cultural, and professional information sources not only from the sight of assimilation for solving particular learning problems, but also as a means of self-development that ensures success and competitiveness in the contemporary labour market. Particularly important become such learning skills as a self-directed information search and knowledge extraction, an acquisition of prospective ways to apply knowledge in various situations, creative and research activities in the extensive digital environment. In this context, students' autonomous learning plays an important role and ensures self-education and self-organisation, which are demanded for lifelong learning.

In a complex, rapidly changing world, a comprehensive support of a person as a "full-fledged" author of his life is significant for education, because it helps to expand the range of learning outcomes (Wannemacher, 2016). We need a focused transition from traditional reproductive students' interaction with educational resources, to the production methods that provide the ability to construct knowledge in personal or joint activities and to produce new information products. The implementation of such a paradigm is impossible without the personalisation of learning activities.

Publications on e-learning and digital learning technologies often focus on the content and formats of learning resources (Lafuente, 2017; Lopez-Rosenfeld, 2017; Nau, 2017). However, internal psychological factors (attitudes, motivations, and aspirations of a learner) also determine the effectiveness of a knowledge extraction. Accordingly, in the digital environment, not only a diversity of content, resource presentation modes, and teaching methods should be considered by a teacher, but also a "cognising subject" (a learner) and his information behaviour (Noskova et al., 2018).

The following issues of the design of the digital resources are problematic:

- the core changes in the representation of knowledge in the educational computer systems;
- the ways to get the most advantages of the open digital educational environment;
- the new types of learning tasks that can be solved with digital resources and tools;
- personalised learning activities considering professional digital transformation and human information behaviour;
- students' engagement in the implementation of the lifelong learning strategy, which is a prerequisite for the success of upcoming professional activities.

The main objective of the paper is to study the diversity of students' information preferences in the digital learning environment. We hypothesise that students use a variety of information sources, but they mainly apply the methods of work that they have mastered in the "traditional" (face-to-face) learning paradigm. To a lesser extent, they use the potential of the digital environment associated with collaboration, knowledge exchange, and knowledge extraction from non-adapted (authentic) sources. In other words, students do not use the entire potential of the digital learning environment, which may indicate problems in students' information culture and shortcomings in the methodological support of students' autonomous work.

The paper comprises several sections that describe a theoretical background of the study (what is information behaviour and which sources are available for students in the reach digital environment), methods and materials of the research (aims and structure of the questionnaire for bachelor students), analysis of the obtained results and further discussion of the main issues revealed.

The paper presents an extended and updated version of the report "Diversity of students' information behaviour within a digital learning environment" presented at the 17th International Conference "Efficiency and Responsibility in Education – ERIE 2020" (Noskova, Pavlova and Yakovleva, 2020).

THEORETICAL BACKGROUND

By student's information behaviour, we understand the entirety of human efforts and actions that ensure the search, assimilation, use, and creation of new knowledge, together with its transmission and dissemination in the society (Spink and Cole, 2006; Wilson, 2000). Information behaviour is also considered as a reflection of a personal information culture.

Students and lecturers are increasingly connected by diverse, versatile communication capabilities and digitisation (Huijbers, Sprang and Groen, 2018). Existing pedagogical practices in the digital environment need to be enriched with personality-oriented non-linear educational technologies, providing students a sufficient freedom of learning actions and a possibility of personally understood educational results with satisfaction in the learning process (Laptev and Noskova,

2013). Digital environment instructional design should take into account students' information behaviour models, because the larger part of current learners are digital natives (Noskova, Pavlova and Yakovleva, 2016;.Hayman, Smith and Storrs, 2019; Smith, 2017). Such practices require both technological and methodological restructuring of resource equipment for students' autonomous work. To promote a productive information behaviour of students within a particular learning task framework, a teacher can arrange various learning activities based on the choice of resources, learning methods, and digital tools. At the same time, a teacher needs to reveal and analyse students' preferences in a wide range of information activities. A necessary condition for the students' demand for learning resources new functionality is an open cognitive position purposefully shaped in the educational process. Kholodnaya (2002: 133) defines an open cognitive position as 'a special type of attitude in which individual contemplation is characterised by variability and a variety of subjective ways of understanding the same event, as well as by an adequate susceptibility to unusual aspects of what is happening'. Kholodnaya and Gelfman (2016) stressed that the learning content should have a developing effect and solve the problems of intellectual upbringing. The authors identified learning content features that contribute to a student's open cognitive position shaping. Among these features, a specific information structure is named, which allows integrating declarative and procedural knowledge, contracted and expanded content, contradictions, alternative points of view, complex situations, instructions, cases, etc. The identified relationship between the learning content structure and a personal learning position should find new implementations in the resources of the digital educational environment.

Digital learning resources are considered as the basic component of students' independent activity in an enriched, expanded information space. The pedagogical support priority comprises a personal educational request, personal learning strategy design, and self-realisation in learning activities. Tracking the changing information request of young people who are growing up in a rich media environment is coherent with the idea of a personal digital learning environment. In this context, we rely on the main features of a personal learning environment (Downes, 2010; Attwell, 2007), which allow students to 'regain control of their learning process by being able to choose and mix from several alternatives for (among other actions) capturing, storing, classifying, analysing, creating, sharing, disseminating and processing information, thus creating knowledge' (Kompen et al., 2019: 194).

In the digital learning environment, the principles of connectivity formulated by Siemens (2005) are reflected, which has a significant impact on students' information behaviour. The following provisions may be mentioned as an example:

- 'Learning and knowledge rests in diversity of opinions.
- Learning is a process of connecting specialised nodes or information sources.
- Learning may reside in non-human appliances.
- The capacity to know more is more critical than what is currently known
- Nurturing and maintaining connections is needed to facilitate continual learning.
- Ability to see connections between fields, ideas, and concepts is a core skill.
- Currency (accurate, up-to-date knowledge) is the intent of all connectivist learning activities.
- Decision-making is itself a learning process. Choosing what to learn and the meaning of incoming information is seen through the lens of a shifting reality. While there is a right answer now, it may be wrong tomorrow due to alterations in the information climate affecting the decision' (Siemens, 2005: 5-6).

The study of students' information behaviour is especially relevant in the context of the strengthening trend of blended learning, which is noted in the Educause Horizon Report (2019: 12): 'students report a preference for blended learning, citing flexibility, ease of access, and the integration of sophisticated multimedia'. Therefore, blended learning implementation presumes a special complex of pedagogical methods, digital teaching tools, and providing interaction with digital learning content, educational communication, and learning activities management.

Students' information behaviour analysis in the digital environment denotes new opportunities for interaction with information and people in the process of solving educational problems. A multilevel resource environment of a contemporary student, incorporating both didactically transformed and untransformed ("raw") information, traditional and network communication models. Accordingly, the information behaviour of a student combines actions characteristic of the traditional educational process and new actions, based on the specifics of the digital information space, the possibilities of digital tools, and user interactions. In the open, accessible, and frequently updated digital environment, the ability to correctly formulate search queries and quickly extract the necessary knowledge becomes a priority. These ideas are international trends. They are reflected in the competency frameworks for citizens in general and representatives of specific professions in particular.

For example, in the Russian educational standards of teacher education, there is a category of "systematic and critical thinking" that comprises such competencies as search, critical analysis, and synthesis of information (Order on the approval of the Federal state educational standard of the higher education, a bachelor degree in training 44.03.01 Pedagogical education, Ministry of Science and Higher Education of the Russian Federation, 2018). The Digital Competence Framework for Educators – DigCompEdu – also introduces a category of "digital resources" as one of the important objects of teacher activities (Redecker, 2017). That means that a teacher needs to be ken at identifying, assessing, and selecting digital resources for teaching and learning. The "Europass" initiative relevant for any European citizen offers a digital competences self-assessment grid that includes the "information processing" category reflecting the ongoing development of competencies from basic online search

to proficient search strategies, assessment of information validity, and credibility, and advanced techniques of information retrieval.

The report "Future Work Skills 2020", published in 2011 by the Institute for the Future in Palo Alto (USA) presented a map of professional skills of the future (Future Work Skills Summary Map, 2011). The map along with many important skills (transdisciplinarity, project thinking, intercultural competence, innovative adaptive thinking, the definition of meaning and social intelligence), highlighted the information skills - literacy in the new media environment, cognitive loading management, virtual collaboration, and computational thinking.

In the course of a large-scale study "Competence Foresight 2030" (Skolkovo), in which more than 2500 Russian and international experts took part, a list of "over-professional skills and abilities" was presented (Agency for Strategic Initiatives, 2015). This list as discussed above examples contains the competencies of an information nature. Among them are systemic thinking, programming of IT solutions (management of complex automated systems, interaction with artificial intelligence), project management (the ability to design, plan and organise projects and processes), readiness to work in the mode of high uncertainty and a quick change of conditions (the ability to quickly make decisions, respond to changing working conditions, the ability to allocate resources and manage time).

MATERIALS AND METHODS

Sample of Research

To identify a diversity of students' information behaviour in the digital learning environment, a survey was conducted for the first-year bachelor students of the Herzen State Pedagogical University of Russia. The sample included 500 respondents: age-balanced sample (17-19 years), specifically, 433 (86.6%) female and 67 (13.4%) male students. The gender distribution is not surprising since for many years in Russia there has been a tendency for girls to prevail as students of teacher education. The experimental work was carried out in the frame of the "Infocommunication Technology" course for the first-year bachelor students of the Herzen University (2019-2020 academic year). This is a mandatory course for all first-year students, and it restarts every semester. In this particular study, students from two areas of training took part - future teachers of primary school (300 students, 60%) and future teachers of history, social sciences, and philosophy (200 students, 40%).

The sample was chosen for several reasons. Firstly, during the first year, students are adapting to the university (e.g., they understand the organisation of the learning process, requirements, rules, and recommended sources of information). Secondly, in further learning, they will make use of an autonomous work with information sources even more; therefore, it is necessary to identify problematic aspects that should be analysed. We assumed that students' preferences in the information resources of the digital learning environment could vary for the groups of students in different areas of training.

Research materials

A questionnaire was elaborated to reveal students' understanding of various strategies to interact with digital learning resources and to assess their preferences in digital tools. Respondents were asked to relate statements connected to their behaviour strategies and use of digital resources to a 5-point scale (1 point – never, 2 points – once or twice, 3 – rarely, 4 – often, 5 – constantly). The questionnaire consisted of several sections, combining questions related to the following aspects.

Knowledge acquisition:

- Students' preferences in terms of digital learning content (digitised printed publications, video lectures recorded by teachers, digital presentations and visualisations, interactive content, etc.);
- Selection of reliable, relevant information in various formats;
- Memorisation;
- Comprehension;

A sample question: "Evaluate your preferences in the ways of memorising the necessary terms and facts: tests for training and self-control, flashcard applications, interactive timelines, traditional memorisation".

Knowledge application:

- Processing of digital learning information;
- Analytical and synthetic processing of digital learning information extracted from multiple information sources;
- Attitude to gamification.

A sample question: "Evaluate your preferences in the ways of applying the acquired knowledge: traditional assignments; discussions; peer assessment; compilation of tests, crosswords, quizzes, games; scribing".

Designing a personal information environment:

- Use of MOOCs, micro-learning, mobile resources;
- Personal learning resources database;
- Demand to improve skills in determining effective interaction with digital educational information.

A sample question: "Evaluate your preferences regarding the use of MOOCs in the process of study: tests, lecture fragments, MOOCs to obtain a certificate, MOOCs for self-education".

Joint network activities with digital learning content:

- Collaborate learning;
- Discussions;
- Collaborate digital products;
- Virtual labs, gaming environments.

A sample question: "Evaluate your preferences regarding joint network activities with digital learning content: co-editing documents, online discussion, joint development of digital products, interaction in digital environments".

Pedagogical support of learners' information behaviour:

- Assessment criteria;
- Deadlines;
- Reminders;
- Penalty points;
- Progress bar;
- Rating;
- Badges.

A sample question: "Evaluate your preferences in teachers' management of your learning activities: clear assessment criteria, strict deadlines, reminders, penalty points, progress bar, rating, badges".

Overall, the data on 42 variables were collected and analysed. The answers underwent statistical analysis: descriptive statistics for all questions, including the distribution of answers to questions for all respondents. Due to the nature of survey data, non-parametric tests were used in the analysis. Differences in questionnaire answers between the respondents were detected by Mann-Whitney U-test. All the participants were conditionally divided into two groups according to the features of training – the area of scientific knowledge and future professional activities. Students of the Institute of Childhood (future teachers of primary school) formed the first group and the second group comprised students of the Faculty of History and Social Sciences and the Institute of Human Philosophy (future teachers of history, social sciences, and philosophy). Differences in nominal data among groups were tested Chi-square test or Fisher's exact test. The relationship between the survey questions was analysed with Spearman's rank correlation coefficient. All results were considered significant at $p < 0.05$. The analysis was performed with the statistical package STATISTICA v. 12.0 (StatSoft. Inc., Tulsa, Oklahoma, USA).

RESULTS

General trends in students' preferences in the information resources of the digital learning environment

At the first stage of the study, the data of the whole sample was analysed to identify general trends in students' preferences in the information resources of the digital learning environment. The respondents rated all sources of information and strategies for working with them above the average level of significance (the median of none of the variables was lower than 3). However, the most interesting are the variables that students rated the highest (Me=5) and the lowest (Me=3). They are presented in Figure 1.

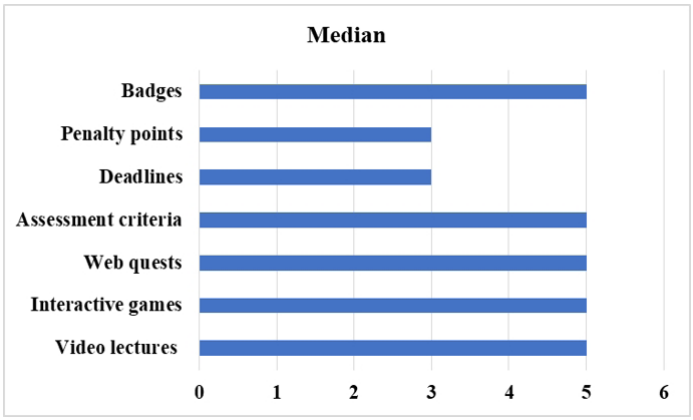

Figure 1: Students' preferences in the interactions with digital educational content (source: own calculation)

The generalised histogram shows a relatively even distribution of students' attitudes to various techniques that organise the interaction with digital educational content. We see that the most highly rated are interactive, gaming, multimedia tools, and methods. Consequently, students prefer high-quality educational videos and interactive training programmes. Besides, students gave a low evaluation of the "hard" methods of pedagogical support (ratings, strict deadlines, and penalty points), feeling that these methods are discrepant from the information behaviour freedom in the digital learning environment. The deeper analysis showed that students do not highly appreciate peer-to-peer evaluation in the process of interacting with digital educational content. This probably indicates a lack of experience and an inadequate understanding of the opportunities for such techniques. The study particularly analysed data on students' preferences regarding sources of digital educational information (Table 1).

The data demonstrates that traditional digitised printed publications still occupy a leading position among the sources of educational information, but learners realise a variety of digital alternatives. However, at the same time, more troubling is that almost 48% of students noted they often use information from unreliable sources. These findings indicate both a low information culture of students and shortcomings in the methodological support of students' autonomous work.

The correlation analysis helped to find relations between the significance of the variables. In the first block of the questionnaire (knowledge acquisition), the closest correlation was found between the variables "tests for self-control" and "tests for training" ($r = 0.6$). In the second block (knowledge application), the correlations between the variables "flashcards" and "interactive timelines" ($r = 0.7$), "interactive games" and "mindmaps" ($r = 0.6$), "infographics" and "quiz making" ($r = 0.4$) were found. In the third block (designing a personal information environment), the correlation between the variables "MOOC lectures" and "MOOC

Sources of information \ Scoring	1	2	3	4	5
Digitised educational publications within an e-course	14	21	20	33	16
E-libraries	3	7	21	32	41
Portals and databases	1	9	21	34	39
Educational video channels and podcasts	6	6	22	23	47
Official scientific and educational sites	2	4	16	38	44
Mass media	3	10	31	29	31
Reputable professionals and scientists personal sites	7	13	25	39	30
Information sites of unspecified affiliation	28	24	8	25	19
Open digital educational resources	2	7	12	28	55
File hosting and torrent trackers	19	14	23	22	26

Table 1: A variety of digital educational information sources used by students, in % (source: own calculation)

tests" (r = 0.7) was revealed. In the fourth block (joint network activities with digital learning content), the correlation between the variables "network discussions" and "virtual labs, gaming environments" was found (r = 0.5), together with the correlation between "web quests" and "didactic games with a virtual agent" (r = 0.8). In the last block (pedagogical support of learners' information behaviour), the correlations were found between the variables "progress bar" and "badges" (r = 0.6), "deadlines" and "penalty points" (r = 0.7).

We see that students perceive the digital learning environment as something created for them and objectively prepared for use. None of the variables related to the design of a personal information environment and joint network activities with digital learning content received the maximum scores.

The survey shows that students are familiar with a variety of capabilities that allow them to interact actively with digital educational content, process it, and create an individualised information product. Preferences regarding gamification are clearly expressed, and that indicates students' willingness to learn interactively. Students prefer educational video content, the source of which can be both open video channels and online courses (videos with a high level of static and dynamic visualisation, expert explanation, and emotional expressiveness). Nevertheless, encouraged to implement various computer practices, many still prefer traditional educational resources. Students demand interactive learning content almost equally with traditional texts, and teachers should not ignore this. Respective to the modern educational process, methods of interaction with digital educational content assume a variety of learning activities, and at the same time require special efforts of teachers and students to minimise risks of the digital information environment redundancy.

Some features of information resources preferences for students from different areas of education

At the second stage of the study, statistically significant differences in the responses of representatives of different areas of training were identified. It should be noted that no statistically significant differences in terms of gender were revealed. Perhaps this is due to the features of the sample, which will be described in the "Discussion" section. The answers will be further described following the structure of the questionnaire - knowledge acquisition, knowledge application, designing a personal information environment, joint network activities with digital learning content, and pedagogical support of learners' information behaviour (Tables 2-6). Answers that have statistically significant difference with $p < 0.05$ are marked in red.

We see (Table 2) that in students' preferences characterising their information behaviour related to knowledge acquisition in the digital educational environment, with many similar features, there are some differences in the groups. Students from the first group, future primary school teachers, prefer video lectures to a greater degree, which is the most traditional form of presenting new material (Q. 2). At the same time, students in this group are very interested in interactive tutorials (Q. 4). This is probably because students are aware that a large number of interactive educational and developmental programs for preschool and primary school age are being created and distributed. Future teachers want to understand and master this way of acquiring knowledge better.

Students from the second group, which brought together representatives of the Faculty of Social Sciences and the Institute of Human Philosophy (future teachers of history, social sciences, and philosophy), more clearly reflected in their preferences such ways of presenting educational information as timelines, interactive flashcards, spreadsheets, interactive exercises on the compilation and comparison of series (Q. 8, Q. 13, Q. 15, Q. 16). In both groups, students showed that they understand the need to improve their information behaviour in the process of acquiring knowledge (Q. 17). At the same time, it should be noted that the range of preferences is significant, i.e. some students express a sharp rejection of digital interactive forms of interaction with educational information or completely reject traditional methods. Nevertheless, a median of "4" for almost all questions in this section of the survey demonstrates students' desire to use all these forms in the educational process.

Students' preferences in terms of the digital techniques used for knowledge application did not show significant differences (Table 3). We can only note a few more preferences of students from the second group expressed about online discussions, which is associated with the peculiarities of the areas of learning, including the comprehension of a large number of complex ambiguous problems. In general, students show a high willingness to act in different ways and in different digital formats in the process of solving educational problems on the application of knowledge in new situations.

Questions	Descriptive statistics Me (IQR)*				*p*-value
	Group 1 *N*=300 (Institute of Childhood)		Group 1 *N*=200 (Faculty of History and Social Sciences; Institute of Human Philosophy)		
	Mean	Me (IQR)*	Mean	Me (IQR)*	
Q. 1 Traditional digitised printed publications	4.009	Me=4 (3 – 5)	4.429	Me=4 (1 – 5)	0.048
Q. 2 Video lectures	4.435	Me=5 (2 – 5)	4.364	Me=4 (3 – 5)	0.043
Q. 3 Digital presentations and visualisations	3.930	Me=4 (1 – 5)	3.860	Me=4 (1 – 5)	0.367
Q.4. Interactive training programmes	4.345	Me=4 (3 – 5)	3.730	Me=4 (1 – 5)	0.245
Q. 6. Tests for training and self-control	3.990	Me=4 (1 – 5)	3.970	Me=4 (3 – 5)	< 0.001
Q. 7. Flashcards (Quizlet, Flashcard Exchange, BrainFlips, etc.)	3.772	Me=4 (1 – 5)	3,405	Me=4 (2 – 5)	0.380
Q.8. Interactive timelines (Timegraphics)	3.376	Me=4 (1 – 5)	4.434	Me=4 (2 – 5)	0.254
Q. 9. Traditional memorisation	3.574	Me=4 (1 – 5)	4.011	Me=4 (2 – 5)	0.134
Q. 11. Mobile polls	3.931	Me=4 (1 – 5)	3.926	Me=4 (2 – 5)	0.044
Q. 12. Interactive didactic games	4.287	Me=5 (1 – 5)	4.101	Me=4 (2 – 5)	0.018
Q. 13. Mind maps	3.821	Me=4 (1 – 5)	4.223	Me= (2 – 5)	0.276
Q. 14. Tests	3.811	Me=4 (1 – 5)	3.827	Me=4 (2 – 5)	0.144
Q. 15. Filling in tables (conceptual, comparative, etc.)	3.611	Me=4 (1 – 5)	4.330	Me=4 (2 – 5)	0.132
Q. 16. Interactive exercises on the compilation and comparison of series	3.703	Me=4 (1 – 5)	4.630	Me=4 (2 – 5)	0.351
Q. 17. Intention to develop new ways of building knowledge	4.454	Me=4 (3 – 5)	4.433	Me=4 (3 – 5)	< 0.001

Table 2: Knowledge acquisition (*Me – median, IQR – interquartile range) (source: own calculation)

Questions	Descriptive statistics Me (IQR)*				*p*-value
	Group 1 *N*=300 (Institute of Childhood)		Group 1 *N*=200 (Faculty of History and Social Sciences; Institute of Human Philosophy)		
	Mean	Me (IQR)*	Mean	Me (IQR)*	
Q. 18. Traditional assignments	3.801	Me=4 (1 – 5)	3.821	Me=4 (2 – 5)	0.142
Q. 19. Discussions with peers (forum, discussion in the social network)	4.108	Me=4 (1 – 5)	4.444	Me=4 (2 – 5)	0.015
Q. 20. Joint development of information products (wiki, online documents, etc.)	3.703	Me=4 (1 – 5)	3.711	Me=4 (2 – 5)	0.212
Q. 21. Compilation of tests, crosswords, quizzes, games	3.851	Me=4 (1 – 5)	3.703	Me=4 (1 – 5)	0.648
Q. 22. Scribing (explanation through sketches, drawings), services like Sparkol (stylistics of drawing with a felt-tip pen)	3.584	Me=4 (1 – 5)	3.331	Me=4 (1 – 5)	0.439
Q. 23. Intention to improve the ability to apply knowledge in a digital environment	4.315	Me=5 (3 – 5)	4.431	Me=4 (3 – 5)	0.012

Table 3: Knowledge application (*Me – median, IQR – interquartile range) (source: own calculation)

Questions	Descriptive statistics Me (IQR)*				*p*-value
	Group 1 *N*=300 (Institute of Childhood)		Group 1 *N*=200 (Faculty of History and Social Sciences; Institute of Human Philosophy)		
	Mean	Me (IQR)*	Mean	Me (IQR)*	
Q. 24. Create a bookmarking system for educational Internet resources	3.801	Me=4 (1 – 5)	4.406	Me=4 (3 – 5)	0.317
Q. 25. Use subscriptions to updated educational online resources	4.158	Me=4 (1 – 5)	4.537	Me=4 (3 – 5)	0.081
Q. 26. Use the materials of MOOCs in the process of studying	3.403	Me=3 (1 – 5)	3.603	Me=3 (2 – 5)	0.031
Q. 27. Systematise educational information on a local computer or a portable device	4.851	Me=4 (3 – 5)	4.830	Me=4 (3 – 5)	0.126
Q. 28. Organise educational information in a cloud storage	3.384	Me=3 (1 – 5)	3.217	Me=3 (3 – 5)	0.219
Q. 29. Use the capabilities of file managers (colour marking, sorting and filtering files, synchronising directories, etc.)	3.102	Me=3 (1 – 5)	3.056	Me=3 (3 – 5)	0.311
Q. 30. Reliably ensure the safety of important educational information (backup, archiving, anti-virus protection, synchronisation of information on different devices and in cloud storage)	3.406	Me=4 (1 – 5)	3.468	Me=4 (2 – 5)	0.142
Q. 31. Intention to improve the skills of designing a personal information environment	4.283	Me=5 (3 – 5)	4.346	Me=5 (3 – 5)	0.024

Table 4: Designing a personal information environment (*Me – median, IQR – interquartile range) (source: own calculation)

The questions focused on identifying the features of students' information behaviour in terms of designing a personal information environment, pursued an obvious goal - to attract the attention of students and to emphasise the importance of their activity in this aspect (Table 4). The data corresponding to this section of the survey showed a number, albeit not very significant, of differences in students' attitudes to ways of organising, storing, updating useful and necessary digital resources in training. For example, students from the second group take the issues of interacting with relevant information resources and receiving updated information more seriously (Q. 24).

Students of the studied groups showed that they rather far from using the possibilities of ensuring security and information management in their personal information environment. The demand for materials from MOOCs in the process of learning is rather low (Q. 26: Me=3). A likely result of focusing on students' problems of the active formation of their personal information environments was the answer to the question about the intentions to improve the ability to design a personal information environment (Q. 31: Me=5; IQR=3-5).

Questions	Descriptive statistics Me (IQR)*				*p*-value
	Group 1 *N*=300 (Institute of Childhood)		Group 1 *N*=200 (Faculty of History and Social Sciences; Institute of Human Philosophy)		
	Mean	Me (IQR)*	Mean	Me (IQR)*	
Q. 32. Co-editing documents	3.881	Me=4 (1 – 5)	3.673	Me=4 (2 – 5)	0.041
Q. 33. Blogging, activity in online educational communities	4.089	Me=4 (1 – 5)	4.320	Me=4 (2 – 5)	0.244
Q. 34. Joint development of digital content	3.653	Me=4 (1 – 5)	3.549	Me=4 (2 – 5)	0.313
Q. 35. Interaction in digital environments (virtual laboratories, virtual worlds, gaming environments)	3.831	Me=4 (1 – 5)	3.852	Me=4 (2 – 5)	0.021
Q. 36. Intention to improve the skills of joint network learning activities	3.950	Me=4 (1 – 5)	3.778	Me=4 (2 – 5)	0.028

Table 5: Joint network learning activities (*Me – median, IQR – interquartile range) (source: own calculation)

Joint forms of work, communication, cooperation are the most significant advantages of the digital educational environment. The corresponding section of the survey was designed to identify students' preferences in terms of joint actions in the process of solving educational problems (Table 5). There were no significant differences in the studied groups, except for the last question, related to the desire to improve the skills of joint network learning activities (Q. 36). Future primary school teachers are more aware of the need to fully unfold the educational potential of network communication.

Questions	Descriptive statistics Me (IQR)*				*p*-value
	Group 1 *N*=300 (Institute of Childhood)		Group 1 N=200 (Faculty of History and Social Sciences; Institute of Human Philosophy)		
	Mean	Me (IQR)*	Mean	Me (IQR)*	
Q. 37. Assessment criteria	4.337	Me=5 (1 – 5)	4.427	Me=5 (2 – 5)	0.018
Q. 38. Deadlines	3.198	Me=3 (1 – 5)	3.185	Me=3 (2 – 5)	0.027
Q. 39. Penalty points	3.049	Me=3 (1 – 5)	3.117	Me=3 (2 – 5)	0.038
Q. 40 Visual progress bar	4.080	Me=4 (1 – 5)	4.169	Me=4 (2 – 5)	0.218
Q. 41. Ratings	4.059	Me=4 (1 – 5)	4.036	Me=4 (2 – 5)	0.421
Q. 42. Badges	4.119	Me=4 (1 – 5)	3.917	Me=4 (2 – 5)	0.287
Q. 43. Intention to improve the skills of self-management	4.256	Me=4 (1 – 5)	4.273	Me=4 (2 – 5)	0.349

Table 6: Pedagogical support of learners' information behaviour (*Me – median, IQR – interquartile range) (source: own calculation)

The results of the survey section on the pedagogical support of learners' information behaviour (Table 6) showed that students of both groups are positive about the fact that clear criteria for evaluating their actions with educational information resources are important (Q. 37). A negative attitude is shown by students concerning "hard" management practices, which reflects their correct understanding of the basic capabilities of the open digital learning environment, which is designed to expand the freedom of information and educational activities (Q. 38, Q. 39: Me=3). Students of the first group showed great interest in using the reward system, which corresponds to their general preferences in the application of gamification techniques (Q. 42). A median of "4", obtained for most of the answers to the questions in this section, indicates that students understand the need to not only increase the saturation of their information environment, to make it more structured, but also strive for manageability of the information space and educational activities. Quite high values of the average score for answers to the question about the desire to improve self-management skills while working with educational resources indicate the correct vector for improving students' information behaviour (Q. 43).

Summing up, when building the educational process in the digital environment, it is necessary to take into account students' information preferences. There might be some differences in the information behaviour of students studying in different directions. The range of results also indicates the need to take into account different requests, which is impossible without providing the greatest possible freedom of information. This does not mean that electronic courses and digital content, in general, should be provided in all possible formats. Nevertheless, this means that students should be able to use as many digital techniques and tools as possible for the interaction with educational information and processing it while developing new competencies.

DISCUSSION

Issues of students' educational preferences in the information resources of the digital learning environment are considered today in different contexts. In a global context, Skalaban et al. (2020) note that analysis of students' preferences is closely related to the competition of universities in the educational services market. For example, the revealed interest of students in open educational resources is an incentive for their creation by universities. This makes the university more attractive, open, and modern.

The digital learning environment gives the ground for the personalisation of learning. Personalisation provides such a curriculum design when a learner follows a personal learning path (Nabizadeh et al., 2020). It is important to review the indicators of efficient information behaviour and make efforts to support students' self-management, initiative in learning, and personal productivity. Personalisation affects the quality and cost of education (Iatrellis et al., 2020).

Personalisation of information behaviour in the digital learning environment is one of the problems of education (Han and Ellis, 2020). Personalisation requires simultaneous consideration of many factors, e.g., risks of dripping out (Xing and Du, 2019), need for emotional support, and behavioural regulation (Zojaji and Peters, 2019). Quantities and correlations of these factors are not constant and alter in the educational process. Personalisation of learning is ensured by both an active student's position

and a quality of digital learning environment (information, communication, management conditions).

In this paper, we propose five directions to reveal students' understanding of various strategies to interact with digital learning resources and to assess their preferences in digital tools - knowledge acquisition, knowledge application, designing a personal information environment, joint network activities with digital learning content, and pedagogical support of learners' information behaviour.

Referring to similar studies in the listed areas, we can note that the questions of students' preferences in knowledge acquisition, knowledge application are closely connected. Thus, Bates (2015) found that "at a university level we need strategies to gradually move students from concrete learning based on personal experience to abstract, reflective learning that can then be applied to new contexts and situations. Technology can be particularly helpful for that". For example, when designing an e-course, it is advisable to provide learners with variable media resources, ensuring "'richness' of possible content". Therefore, if we strive to design a diverse digital environment and provide students with a choice of learning activities, we need to be aware that by the means of a "manual control", it is not feasible to support students' interaction with "redundant" learning resources. The digital learning environment has special tools for a dynamic data analysis (users' input and their so-called "digital footprints") to provide deeper information on learners' decisions and activities.

To enrich the capabilities and functionality of digital educational activities, a granular digital learning content approach is promising. It assumes multiple, varied methods for its inclusion in the learning process. The diverse students' information behaviour prerequisites are not at the level of available digital tools, but at the level of the teaching methodology in the digital environment. This methodology reflects the specifics of the digital educational environment in the following key areas:

- Expanded range of educational goals, with the focus on prospective cognitive, social, digital skills (Mayer, 2019);
- Extended and varied digital learning content (Jagušt and Botički, 2019);
- Various semiotic systems and information structures of digital learning content (Sansone et al., 2020);
- Techniques and technologies for enhancing and personalising interaction with learning content and digital educational communication (Segal et al., 2019).

Belyakova and Zakharova (2019) studied some features of university students' interaction with educational content. They identified typological groups of learners in terms of general activity of referring to educational resources, as well as in terms of resource content - "passive", "active", "advanced", "professionally-oriented" and "humanities". In the study, students of all courses showed high activity in using digital and printed educational resources (preferably in text format) and low activity in working with such educational content as audio lectures, electronic simulators, and open e-courses (including MOOCs). Resembling results were obtained by Wilhelm-Chapin and Koszalka (2020), who showed that e-text and video tutorials were the most demanded sources of information within the e-course.

Johnston and Salaz (2019) proved students' remaining demand for printed learning materials. However, the main reasons for that along with eyestrain, tactile features were the ability to highlight and take notes. That might mean that it is important for students to actively master new knowledge. Perhaps, they need not just digitised textbooks, but interactive materials with the ability to adapt them to their thinking process. Information technology development demonstrates a proactive influence on educational environment design that enables new forms, methods, and technologies of learning activities. The learning activity shifts toward interactivity, variability, and ambiguity of learning contexts. This trend is reflected in the educational science research (Takev, Rodriguez-Artacho and Somova, 2019; Farrow, De Los Arcos and Pitt, 2016).

Designing a personal information environment is an important area of research. To acquire prospective competencies in terms of interaction with information, from the very beginning of training a student needs to be in a gradually expanding information environment. This is possible due to a systematic transition from working with digital resources selected by the teacher to resources from the ubiquitous information environment, including interdisciplinary and foreign resources. An authentic learning approach also highlights these ideas of "meaningful, real-life situations" for acquiring new skills (Iucu and Marin, 2014: 410).

Performing such sometimes-difficult tasks as analysis of digital libraries, work with bibliographic lists and annotated catalogues, systematisation of links to information sources on a personal website, mind mapping, and visualisation, a student becomes aware of personal preferences of information sources, develops an individual style of activity, personal strategy of information behaviour. This will become the basis of a personalised educational path based on open educational resources (e.g., MOOC platforms) for lifelong learning. Prospects are individualised educational products that meet the needs of both students and employers.

Along with the study of new information, the modern learning process is impossible without interaction and co-working - joint network activities with digital learning content. Therefore, of interest are also questions of students' preferences in communication resources that support collaborative knowledge building (Duvall, Matranga and Silverman, 2020). Kent and Rechavi (2020) propose several types of interactions among learners: "digitally speaking" (learners who contribute content), "digitally listening" (learners who prefer consuming content), and "organisation of digital content". This discovery confirms the relevance of the study of students' preferences in joint network activities with digital learning content. Thus, Sleeman, Lang and Dakich (2020) showed that students' involvement in collaboration and communication via social media contributes to their engagement in learning and co-working with their peers, which is particularly important for international students' academic learning and social adjustment.

Pedagogical support of learners' information behaviour was researched by Hegarty and Thompson (2019) in the context of student-centred learning. The authors observed that regular feedback from the teacher (e.g., with the help of mobile technologies) contributes to the development of learner capability (critical thinking, social justice awareness, reasoning). Somyürek, Brusilovsky and Guerra (2020) went deeper into the issues of feedback and described several models of assessment that could be used in e-courses - open learner modelling (when a learner assesses

himself) and open social learner modelling (when a learner can compare his outcomes with other learners). Both models help to improve students' self-assessment skills, however, the second model contributes to the relative knowledge assessment that is very important for understanding the reasons for being superior or inferior. This understanding is connected with social comparison as a mechanism of self-knowledge. The findings of our study also lie in this context because students showed preferences in such digital tools that help to improve the skills of self-management - visual progress bar, rating, etc. Kuzmanović, Andjelković-Labrović and Nikodijević (2019) revealed two typological groups of students according to their attitude to pedagogical support within an e-course – "results-oriented" (who prefer to study more at their own pace and have prepared content-on-demand) and "process-oriented" (who prefer to be "in the process of learning" through classroom live broadcasting).

There are several limitations of the particular study described in the paper. The first limitation emerges from the research sample that involved mostly female young participants from the humanitarian area of education. The second limitation is related to the learners' ICT experience. First-year students effectively apply technology to solve everyday problems, but they have not yet acquired enough experience in their application in solving educational and future professional problems. The third limitation is associated with the national and socio-cultural conditions of higher education in Russia, together with the particular case of the pedagogical university. Nevertheless, the findings can be beneficial for other universities in terms of e-learning practices, digital content design, facilitation, and support of students' autonomy in the learning process. The listed limitations help to see the prospects for further research.

CONCLUSION

Summing up, we can offer recommendations on creating conditions for students to master prospective strategies for interacting with digital resources. These approaches apply to the development of e-learning courses.

It is necessary to implement a gradual change in the ratio of selected, didactically transformed, and untransformed information, including foreign language sources. Along with this, attention should be paid to digital tools that facilitate the solution of information processing tasks: automated intellectual translation, work with knowledge bases, conceptual mind maps, etc. This will allow students to master the competencies of critical thinking, systemic thinking, and intercultural communication.

The preferences of students in the field of digital resources should be taken into account: the digital environment should offer them not only numerous text materials, but also multimedia, video lectures, interactive tasks, and tests. Productive is the use of gamification techniques to increase motivation and enhance the learning process. It is important that students not only can receive ready-made resources, but also take part in creating their information products, share them with peers, and discuss.

Particular attention should be paid to management issues in the digital environment. The priority of flexible management approaches is needed, as students feel the possibilities of educational freedom in the digital environment. However, the teacher can use many tools to monitor student activity. We are talking about persisting and accumulating "traces" of students' educational activities. Digital footprints in the accumulative mode allow us to track personal indicators of students' development and learning outcomes (electronic portfolio), to analyse students' activity, information, and communication and technological preferences in the learning process. The study of different types of educational activity of students (their frequency and rhythm) in the digital environment, comparing the values with the average indicator in the group allows us to assess the regularity of educational activity, the ability to work independently, to determine an individual learning style.

The issues of students' information behaviour, capabilities, interests, aspirations, and initiatives in the digital learning environment, need further reflection. This complex problem leads to the new pedagogical design of the digital learning environment and its methodological and technological transformation. Students' open learning positions and innovative ways of productive interaction with information are of particular importance because knowledge and technology change rapidly. The value of the ability to learn independently, to choose optimal resources, strategies, and tools increases significantly. On the one hand, diverse activities with digital content are highly demanded by students, but their expectations are not always justified by real educational practices. On the other hand, students sometimes prefer to act in traditional ways, having insufficient experience of an autonomous learning activity in an open digital environment.

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