

PAPER

The Impact of Socio-Demographic Factors on the Use of Digital Learning Platforms and Forms of Learning by Generation Z Engineering Students

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ABSTRACT

The demands on higher education are increasing with the rise of generation Z. The emphasis is put on dynamism, a fast pace of teaching, dividing teaching into smaller blocks, alternating methods, digital tools, and using the possibilities of modern technologies. Educators must continually innovate and build improved pedagogical strategies in engineering to support student learning. Therefore, it is necessary to constantly innovate and build more sophisticated educational strategies with an impact on direct teaching and to support student learning. The aim of this study is to investigate the influence of socio-demographic factors (gender, field of study, and form of study) on the use of digital platforms and preferred forms of learning among Czech generation Z university students. The study emphasizes the preferences of generation Z students in engineering degree programs compared to students in economics and humanities degree programs. This comparison results from differences in teaching delivery and learning styles or methods. Hypotheses are tested using the Chi-square test and Cramer's *V*. Engineering students prefer videos with a deeper explanation of the problem, and they mainly use the MS Teams platform and platforms allowing formative assessment and expression of their attitude. The practical implication of the study for education is mainly the identification of the basic characteristics of an appropriate educational strategy reflecting the needs of generation Z representatives. The article discusses the use of experimental and laboratory teaching. Similarly, as in the Czech Republic, also in the international environment, the project method, e-learning, gamification, Massive Open Online Courses (MOOCs), or videos in microlearning format are used in working with generation Z in engineering education. The study highlights the need to explore the influence of social factors and gamification elements in learning.

KEYWORDS

generation Z, digital platforms, forms of learning, engineering, socio-demographic factors, university

Berkov, K., Kubiřov, A., Krelov, K.K., Krplek, P., Holekov, L. (2024). The Impact of Socio-Demographic Factors on the Use of Digital Learning Platforms and Forms of Learning by Generation Z Engineering Students. *International Journal of Engineering Pedagogy (ijEP)*, 14(8), pp. 4–23. <https://doi.org/10.3991/ijep.v14i8.50279>

Article submitted 2024-05-27. Revision uploaded 2024-08-19. Final acceptance 2024-08-19.

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1 INTRODUCTION

Representatives of generation Z currently make up the predominant wave of new students starting their higher education [1]. generation Z has different characteristics in relation to learning compared to the previous generation of college students. Differences can be seen in particular in the areas of technology and digitalization in education, values and attitudes, learning preferences, and communication [2], [3], [4]. Given the above characteristics of the current generation, their start of university studies brings different challenges, including approaches to learning and assessment of learning outcomes. Representatives of generation Z expect and strongly prefer to deliver and receive information through digital media [5]. More than ever, universities need to rely on the application of the latest technologies and enable students to actively engage in the learning process by allowing them to use their own devices and applications within teaching. Teaching should be dynamic; the fast pace of learning suits generation Z students and prevents unwanted distractions [6]. Behavior and future perspective in connection with education of generation Z representatives is studied quite intensively in engineering degree programs. This is confirmed in the study that reports the results of research with over 750 generation Z students from 15 institutions of various sizes and types across the country. The study provided insight into the perspectives, styles, preferences, interests, and beliefs of this generation in relation to politics, motivation, communication, social issues, community engagement, relationships, leadership, and learning [7].

The aim of the study, to be carried out in the first semester of 2024, is to find out which digital tools are used for learning by the current generation of generation Z students in engineering, economics, and humanities degree programs in university environments. The need for the study is triggered by the expansion of the digitalization of education and the necessity to conceptualize new learning strategies based on scientific knowledge using digital learning platforms and tools or applications. The study is oriented to determine the frequency of use of digital platforms by university students and their preferred forms of learning in terms of video, audio, or text-based materials depending on socio-demographic factors (i.e., gender, field of study, and form of study). The study emphasizes the preferences of generation Z students in engineering degree programs compared to students in economics and humanities degree programs. This comparison results from the differences in teaching delivery and learning styles or methods. Engineering education has its specifics. It also requires laboratory activities in the learning process, specific material and technical support, digital provision, and laboratories. These aspects require the selection of adequate teaching methods and learning forms [8]. The results of the current study will be helpful for designing appropriate educational strategies that also reflect the needs of current university students—generation Z, especially in engineering degree programs.

The following hypotheses emerged from the research objectives:

- H1: The use of digital platforms to support learning by university students depends on socio-demographic factors (gender, field of study, and form of study).
- H2: The preferred forms of learning (video, audio, and text) by university students depend on socio-demographic factors (gender, field of study, and form of study).

2 LITERATURE REVIEW

An empirical study [9] evaluates the impact of socio-demographic factors in the sphere of digitalization of education from the point of view of generation Z as significant in that they are creative, sensitive, fragile (snowflakes), individualistic, more open to diversity, and even more technologically oriented than previous generations. Another study exploring the same theme [5] applauds these findings and adds that this has increased the digital literacy and information skills of generation Z, enhancing flexibility in relation to different digital platforms for collecting, selecting, sharing, and exchanging information. In addition to their susceptibility to distraction, generation Z faces certain risks to the effectiveness of their learning processes, such as overuse of multitasking skills, loss of face-to-face communication skills, infantilism, individualism, different reading methods, lack of skills in analytical evaluation of text and rendering its meaning, lack of self-confidence, hyperactivity, feeling overprotected, preference for games instead of serious work, vulnerability to challenges, impatience, and preference for speed over accuracy [6]. generation Z is a technologically strong generational cohort, relying on a greater number of always-connected devices, thus having multiple sources of information and the ability to process it flexibly. Moreover, they are comfortable with online communication and collaboration and tend to prefer working online to face-to-face communication. Appropriate digital learning platforms for generation Z are therefore diverse applications of digital resources, integration of virtual environments, linking different forms of communication and interaction in the learning process, and enabling the use of collaborative tools. This characteristic is typical not only for students in the humanities but also for engineering education [7]. However, experiential learning in engineering education is more technically and digitally demanding compared to the needs of the humanities or economics fields of study. Presently, there is also dominance of virtual laboratories in engineering education that complement or replace hands-on labs [8]. Related to this fact, the choice of forms and methods of teaching by lecturers and forms of learning by students is being chosen [7]. generation Z students have different learning needs than their predecessors. Results of the study [10] show that the use of mobile applications had a positive impact on students' vocabulary acquisition performance and was rated by them as more enjoyable than traditional teaching methods. Moreover, it contributed to the collaborative learning mentioned above. In the era of "post-pandemic learning," there are four main themes: (1) learning that is not monotonous; (2) balanced portions of theory and practice; (3) ideal instructor-driven learning; and (4) the need for the application of blended learning [11]. Generation Z brains are structurally different from previous generations. Their brains are surrounded by complex visual imagery, and the parts of their brains responsible for visual skills are more developed and thus more receptive to "visual learning," but with shorter attentional retention times. Educators need to change their approach to teaching and deliver concepts in shorter segments; the attention span of generation Z members is only eight seconds [12]. For generation Z, independent learning is gaining importance. From web searches and e-books to digital apps, YouTube, wiki resources, and virtual assistants, college students have found their own ways to find answers [13]. Empirical findings have shown that the influence of digital media on the attitudes of generation Z is greater than that of previous generations. According to this study, members of generation Z with higher educational attainment are more likely to be influenced by digital media,

which is explained by their heavy reliance on digital media and their greater mastery of the skills needed to search for information online [14]. In addition, there is the phenomenon of gamification, which particularly encourages generation Z users. Gamification is useful for satisfaction with the information retrieval system, especially when game elements are embedded in the system according to users' preferences [15].

3 MATERIAL AND METHODS

3.1 Data and procedure

The process phase of the research was conducted on a quantitative and empirical basis. The study was carried out in the first semester of 2024. The subject of the study was to investigate the experience of generation Z—students of engineering, economics, and humanities at university—with digital platforms and online learning tools to support learning on campus or in the home environment and to make a cross-disciplinary comparison of the experience of generation Z. The study is oriented towards identifying the frequency of use of digital platforms by university students and their preferred forms of learning in terms of video, audio, or text-based materials depending on socio-demographic factors (i.e., gender, field of study, and form of study). The study is based on empirical studies that have examined the characteristics of generation Z representatives in relation to learning and the use of digital tools in education [2], [3], [4]. Among the digital platforms and learning tools for which students' experience of using them for learning has been investigated, according to the current studies [2], [16], [17] and examples of good practice and the peer review method, the following have been selected and labeled:

- Moodle: Learning management system (LMS) Moodle;
- Teams' basis: MS Teams at the basic level, which allows online transfer and upload of study and further documents;
- Teams progress: MS Teams at a more advanced level, which allows you to control more applications, create questionnaires, quizzes, and assess tasks;
- Classroom: Google classroom; and
- Poll: Online learning platforms for voting and formative assessment (Kahoot, Sli.do, Mentimeter).

According to the current studies [16], [18], and examples of good practice, the preferred learning modalities for which students' experiences of using them for learning have been investigated include the following:

- Video: Video in the form of pre-recorded lectures with basic explanation and deeper analysis of specific topics with added visualization elements;
- Audio: Audio track—audio—in the form of podcasts, interviews with experts, audio books without visualization; and
- Text: Study materials in the form of text such as professional books, textbooks, scripts, and professional articles on the Internet.

The reason for selecting these digital platforms and forms of learning was to compare the preferences of generation Z undergraduates in different fields

of study, which stems from at least four general characteristics in which this generation differs from previous generations. These are: a) technology and digitalization [2], b) values and attitudes [19], c) educational preferences [3], [18], and d) communication [4].

The choice of digital platforms and forms of learning was firstly assessed with respect to existing studies, followed by peer review [20], [21], processed by three researchers at the same professional level. This evaluation method was carried out in three-rounds. In the first round, digital platforms and forms of learning were blindly selected based on current studies and examples of good practice. In the second round, the results were shared with all reviewers and discussed with them. The third round had the form of an output selection of digital platforms and forms of learning, which was based on the consensus of the majority of reviewers, i.e., at least two.

3.2 Research sample

The research population was focused on the younger generation Z from the university environment. Therefore, the study was oriented towards students of full-time and combined bachelor's degree programs. The study involved two universities from the Czech Republic that implement engineering, economics, and humanities bachelor's degree programs. The selection of the universities was determined by the researchers' direct teaching experience with the environment. The criteria for the selection of the universities were also the diversity of the fields of study and the form of study to increase the reliability of the data in terms of exploring the students' experience of using digital platforms for learning and exploring their preferred forms of learning. These aspects vary with the characteristics and aims of the study programs and courses [22], [23]. The selection of the respondents within the selected universities was done in a deliberate selection with respect to the above-mentioned criteria and was conditional on the age of the students up to and including 24 years, which corresponds to the age of the current generation Z occurring at the university at the undergraduate level. The selection of universities can be considered representative with respect to the broader higher education environment in the Czech Republic in terms of the implemented study programs. The study focuses on representatives of generation Z from the most frequently implemented groups of study programs at universities [24]. One of the selected universities has an abundance of engineering degree programs, from which it was possible to include representatives of generation Z in the research. Out of a total of 4,500 students contacted, 558 respondents participated in the survey and were interested in indicating their experience of using digital platforms for learning and their preferences in terms of learning formats. Direct experience with these aspects of learning was also a condition for their participation in the survey. The resulting number of respondents was determined by the deliberate selection of universities and the condition of the participation of students from these study programs. The lower return rate can be attributed to the timing of the survey, which took place during the exam period, and therefore student participation may have been lower. The aim was to differentiate the research population (refer to Table 1) according to socio-demographic factors, i.e., gender, field of study, and form of study.

Table 1. Structure of the study sample

Variable	Absolute Frequency	Relative Frequency (%)
Gender (<i>n</i> = 558)		
Male	430	77.1
Female	128	22.9
Field of study (<i>n</i> = 558)		
Engineering field	106	19.0
Economic field of study	392	70.3
Humanities	60	10.8
Form of study (<i>n</i> = 558)		
Presentation form	324	58.1
Combined form	234	41.9

3.3 Collection method

The questionnaire method was used for data collection to meet the requirements for hypothesis testing. This method is widely used in education for these purposes [25]. Considering the objectives of the study and the resulting research questions, this method and research instrument were judged to be appropriate. This is evidenced by other studies that underpin the methodological part of the paper. The conceptual focus of the questionnaire was inspired by research [26], [27], and [22] aimed at digital learning. The collection was conducted online through a web-based questionnaire. The questionnaire was designed as a non-standardized questionnaire and was distributed to the email addresses of the respondents. In total, the questionnaire was distributed three times (i.e., the first distribution and two reminders). The distribution was done in coordination with the management of the respective departments and faculties, who were instrumental in motivating the students to participate in the study. The survey was anonymized, and all sensitive data was encrypted. The research received ethical review and approval and complied with all institutional procedures. The development of the questionnaire involved three researchers at the same level of expertise. Based on the selection of variables using an evaluative peer review method, there was discussion among the researchers over the ordering of the questionnaire items and the use of the responses. Questionnaire development was a three-round process using the peer review method. The questionnaire is divided into three main sections (refer to Table 2). The first part focuses on respondents' direct experience of using the digital platforms to support learning. The second part focuses on the preferred forms of learning in terms of which forms are most commonly used by generation Z representatives for learning (video, audio, and text). The third part is devoted to identifying the socio-demographic factors of the respondents (refer to Table 1).

Table 2. Substantive questions in the questionnaire, variables in relation to the hypotheses

Topic	Question in the Questionnaire	Response, Type of Variable, and Relationship to Hypothesis
Experience of using digital platforms for learning	Do you use (have direct experience of) these digital platforms in your learning? – Moodle – Teams basis – Teams progress – Classroom – Poll (Explained further in Section 3.1)	1-yes; 0-no. Dichotomous variables Hypothesis 1
Preferred forms of learning	Which form of learning do you prefer and use most often when learning? – Video in the form of pre-recorded lectures with basic explanation and deeper analysis of specific topics with added visualization elements); – Audio track (audio) in the form of podcasts, interviews with experts, and audio books without visualization elements; – Study materials in the form of text such as professional books, textbooks, scripts, and professional articles on the Internet.	4-Yes; 3-Rather yes; 2-Rather no; 1-No. Ordinal variable Hypothesis 2

Validity and reliability were assessed for the research instrument. Six students who fulfilled the characteristics of the main research population were included in this stage. The research instrument was refined in terms of content and wording based on the respondents' comments. It was possible to eliminate such errors and limitations that would lead to misinterpretation of the results obtained. The content validity of the questionnaire was established through a focus group research method conducted with students in face-to-face mode. It was one focus group lasting 90 minutes with two moderators–researchers. Due to the characteristics and scope of the questionnaire and the result of content validation, no other methods were used. The reliability of the questionnaire was measured by computing the Cronbach's alpha. The questionnaire was evaluated as reliable, as the Cronbach's alpha is .743.

3.4 Data analysis

The hypotheses were verified at the 5% significance level and were formulated as null hypotheses for this purpose:

- H_{0-1} : The use of digital platforms to support learning by undergraduates is independent of socio-demographic factors (gender, field of study, and form of study).
- H_{0-2} : The preferred forms of learning (video, audio, and text) by undergraduates do not depend on socio-demographic factors (gender, field of study, and form of study).

The original data are of several types, according to which appropriate statistical tests were selected. Statistical analysis was performed in SPSS. The variables

expressing the characteristics of the sample, i.e., gender, field of study, and form of study, are nominal variables and are used as a sorting factor to perform comparative analyses. The data that are subject to the verification of hypothesis 1, i.e., the use of digital platforms, contain dichotomous variables 0 (does not use) and 1 (uses). To determine the effect of socio-demographic factors of gender and form of study on students' use of digital platforms, the chi-square test was used a 95% confidence level. With respect to the two categorical variables analyzed, the used method is relevant. The test can assess whether the values of one categorical variable (i.e., socio-demographic factor) depend on the values of another categorical variable (i.e., digital platform). *Phi*-coefficient and odds ratio were used to determine the degree of association between dichotomous variables. *Phi*-coefficient is used when the contingency table is a 2×2 table, which fits the data being analyzed. Odds ratios can be used to quantify the strength of the relationship between two dichotomous variables, which could be used in the analysis of the data obtained from the research. Cramer's *V* statistical method was used to find the effect of the factor of field of study on students' use of digital platforms. This method is used to determine the degree of association between two categorical variables in a 2×3 contingency table. It is a numerical value between 0 and 1 that expresses the strength of association between variables. The higher the value of Cramer's *V*, the stronger the association between the variables. It is typically used in data analysis and in statistical tests such as the χ^2 (chi-square) test of independence. The data that are the subject of the verification of hypothesis 2, i.e., preferred forms of learning, contain mostly numerical ordinal variables using a four-point Likert scale from 1 to 4. The scale with an even length was chosen to force respondents to adopt a non-neutral attitude. This type of variable is commonly treated as a numerical variable [28], [29]. The preference of the form of learning is described by the arithmetic mean. Since these traits do not meet the requirement of normality (verified by the Shapiro-Wilk test) but meet the requirement of homogeneity of variances (verified by the Levene test), the Mann-Whitney U test was selected from the two-sample tests to assess hypothesis 2 to determine the effect of gender and form of study on preferred forms of learning at the 5% significance level. The Mann-Whitney U test compares the distribution of values between two groups and determines whether there is a statistically significant difference between them. It is particularly effective when analyzing ordinal or ordinal data. To perform a Mann-Whitney U test, two independent samples from each group that are being compared are necessary. These samples may be of different sizes and may have unequal variances [29]. In order to determine the effect of field of study on preferred forms of learning (hypothesis 2), Welch's ANOVA test was chosen to determine whether between-groups at least one pair of means were statistically significantly different from each other at the 5% significance level. The Games-Howell's post-hoc test was then used to find specific statistically significant differences between groups of respondents divided by field of study into engineering, economics, and humanities. This test can be used to compare all possible combinations of group differences while violating the assumption of homogeneity of variances [29]. The data obtained from the study meet these assumptions.

4 RESULTS

The results are published by sub-domains that are linked to the hypotheses.

4.1 Descriptive analysis

Descriptive analysis shows the frequency of responses from generation Z students ($n = 558$) in relation to the use of digital platforms to support learning (refer to Table 3) and preferred forms of learning (refer to Table 4). The tables present data tracking the percentage frequency of respondents' answers.

Table 3. Descriptive analysis of respondents' answers in relation to the use of digital platforms for learning ($n = 558$)

Tools	Uses (1)		Not in Use (0)	
	Absolute Frequency	Relative Frequency (%)	Absolute Frequency	Relative Frequency (%)
LMS Moodle	201	36.0	357	64.0
Teams' basis	408	73.1	150	26.9
Teams progress	293	52.5	265	47.5
Google classroom	74	13.3	484	86.7
Poll (Kahoot or Sli.do or Mentimeter)	287	51.4	271	48.6

Table 4. Descriptive analysis of respondents' answers in relation to preferred forms of learning ($n = 558$)

Preferred Form of Learning	Yes (4)	Rather Yes (3)	Rather No (2)	No (1)
Video				
Absolute frequency	351	154	41	12
Relative frequency (%)	62.9	27.6	7.3	2.2
Audio				
Absolute frequency	134	197	176	51
Relative frequency (%)	24.0	35.3	31.5	9.1
Text				
Absolute frequency	205	222	112	19
Relative frequency (%)	36.7	39.8	20.1	3.4

The results of the descriptive analysis show that most respondents use the basic level of MS Teams for learning support, which allows online transfer and uploading of studies and other documents (73.1% of responses). 52.5% of respondents use more advanced features of MS Teams, such as the possibility of quizzes, assignment evaluation, etc. generation Z students also, in most cases, use at least one online learning platform (Kahoot, Sli.do, and Mentimeter) for voting and formative assessment (51.4% of responses). generation Z undergraduates hardly use the digital platform google classroom (86.7%), and also the LMS Moodle platform is used by a minority of students (36%). At the level of our sample, it appears that generation Z undergraduates prefer or rather prefer video in the form of pre-recorded lectures with basic explanations and with deeper analysis of specific topics with the addition of visualization elements when learning (90.5% of responses). Learning materials in the form of text are preferred, or rather preferred, by 76.5% of generation Z learners. This is a greater preference for this form of learning compared to audio in the form

of podcasts, interviews, or audiobooks without visuals. This form is preferred, or rather preferred by 59.3% of students.

4.2 The impact of socio-demographic factors on the use of digital platforms to support learning (H_{0-1})

The use of digital forms to support learning by generation Z undergraduates was linked to sorting factors. Hypothesis H_{0-1} was tested the 5% significance level using the chi-square test and 2×2 association table for the factor of gender and form of study. *Phi*-coefficient and odds ratio were used, to determine the degree of association. In the case of the factor of field of study, a 2×3 contingency table was used and the Cramer’s *V* method was used to determine the degree of dependence (refer to Table 5).

Table 5. Significance of the dependence of digital platform usage on socio-demographic factors (H_{0-1})

Tools	Gender			Field of Study		Form of Study		
	<i>p</i>	<i>Phi</i>	<i>OR</i>	<i>p</i>	<i>V</i>	<i>p</i>	<i>Phi</i>	<i>OR</i>
Moodle	.001	.205	3.23	.009	.131	.001	.396	6.88
Teams basic	.001	.352	5.53	.004	.140	.001	.206	2.55
Teams progress	.014	.104	1.65	.667	.038	.176	.057	1.26
Google Class	.369	.038	.78	.073	.097	.044	.085	.61
Poll	.001	.348	6.43	.001	.205	.001	.519	10.45

At the significance level, we reject H_{0-1} . The influence of socio-demographic factors on the use of digital platforms by generation Z college students was found. Gender influences the use of Moodle platforms, the basic and advanced level of use of MS Teams, and the Poll tool for voting and formative assessment. The highest levels of dependence were found for the Teams basic platform (35.2%) and Poll tools (34.8%). Digital platforms found to have significant dependence are used more by males than females (male: Moodle 31.9%; Teams basic 62.9%; Teams progress 42.7%; Google class 9.7%; Poll 47%; female: Moodle 4.1%; Teams basic 10.2%; Teams progress 9.9%; Google class 3.6%; Poll 4.5%). The field of study influences the use of Moodle platforms, the basic level of use of MS Teams, and the voting and formative assessment tools. The highest level of dependence was found for poll tools (20.5%). Digital platforms for which a significant dependence was found are used more by students of economic fields of study compared to the other fields of study studied (economic: Moodle 27.8%; Teams basic 50.2%; Poll 37.3%; engineering: Moodle 6.1%; Teams basic 16.1%; Poll 11.6%; humanities: Moodle 2.2%; Teams basic 6.8%; Poll 2.5%). The forms of studying are influenced by the use of Moodle platforms, the basic level of use of MS Teams, Google class, voting, and formative assessment tools. The highest level of dependence was found in the case of poll tools (20.5%). Digital platforms Moodle, Teams basic, and Poll are used more by full-time students compared to students of combined forms of study (full-time: Moodle 30.3%; Teams basic 47%; Poll 42.7%; combined: Moodle 5.7%; Teams basic 26.2%; Poll 8.8%). The Google class platform is used more by combined form students compared to full-time students (full-time: 6.3%; combined: 7%).

4.3 The influence of socio-demographic factors on preferred forms of learning (H_{0-2})

The forms of learning preferred by generation Z university students were linked to sorting factors. Hypothesis H_{0-2} was tested at the 5% significance level using the Mann-Whitney U test for the factors of gender and form of study (refer to Table 6).

Table 6. Significance of differences in learning form preferences (H_{0-2})

Preferred Form of Learning	Gender p -Value	Form of Study p -Value
Video	.002	.161
Audio	.008	.002
Text	.803	.010

The variable was described by mean and standard deviation with respect to socio-demographic factors (refer to Table 7).

Table 7. Arithmetic mean and standard deviation – gender, form of study (H_{0-2})

Preferred Form of Learning	Mean	Standard Deviation
Video		
Gender – Male	3.549	.684
– Female	3.391	.844
Form of study – Full-time form	3.552	.686
– Combined form	3.457	.775
Audio		
Gender – Male	2.663	.926
– Female	3.008	.874
Form of study – Full-time form	2.633	.927
– Combined form	2.893	.904
Text		
Gender – Male	3.037	.849
– Female	3.305	.748
Form of study – Full-time form	3.022	.853
– Combined form	3.205	.797

At the 5% level of significance, it was found that there were significant differences in preferences for forms of learning in the case of gender. Males, compared to females, have a higher preference for video in the form of pre-recorded lectures with basic explanation and deeper analysis of specific topics with the addition of visualization elements (male: 3.549; female: 3.391). Although audio is the least preferred form of learning in terms of frequency, significant differences in preferences were found for gender. Females have a higher preference for audio format of learning in the form of podcasts compared to males (male: 3.008; female: 2.663). Learning materials in text

form are significantly preferred by both groups of generation Z students equally. At the 95% confidence level of the test, it was found that there were significant differences in the preferences for the learning formats for audio format of learning and learning materials in text form. Both forms of learning are more preferred by students from the combined form of study compared to students from the full-time form of study (refer to Table 7). Learning materials in the form of video are preferred by both groups of students significantly equally. It should be noted that in terms of the frequency of respondents' answers, video ranks among the most preferred forms of learning.

Table 8. Arithmetic mean and standard deviation – field of study (H_{0-2})

Preferred Form of Learning	<i>n</i>	Mean	Standard Deviation
Video			
Economic	392	3.508	.733
Engineering	106	3.557	.705
Humanities	60	3.467	.724
Audio			
Economic	392	2.753	.928
Engineering	106	2.585	.965
Humanities	60	2.950	.790
Text			
Economic	392	3.130	.828
Engineering	106	2.972	.856
Humanities	60	3.117	.825

For the factor of field of study, hypothesis H_{0-2} was tested using Welch's ANOVA test and Games-Howell's Post-Hoc test. Significant differences between at least two means were found at the 5% significance level for the audio form of learning ($p = .034$). No significant differences were found between at least two means for the video form of learning and the text form of learning (video: $p = .716$; text: $p = .237$). According to the averages (see Table 8), it was found that engineering students, compared to students of economics and humanities, preferred most videos to support learning (mean; engineering: 3.557). At the same time, compared to students from other fields of study, they least preferred text-based learning materials (mean; engineering: 2.972) and audio formats in the form of podcasts (mean; engineering: 2.585). generation Z students of the humanities, compared to students from other fields of study, prefer most audio formats in the form of podcasts to support learning (mean; humanities: 2.950). Students of economics, compared to students from other fields of study, prefer most text-based learning material (mean; economics: 3.130).

At the 5% significance level, we reject H_{0-2} . There was a significant dependence of generation Z undergraduates' preferences for forms of learning on socio-demographic factors.

5 DISCUSSION

The current study has provided several key points for building effective educational strategies for the field of higher education towards representatives of

generation Z. This generation is characterized by individualism and technological prowess. Generation Z members, however, lack skills in analytically evaluating a text and rendering its meaning [6]. This finding is confirmed by our research conducted in a higher education setting in 2024. Generation Z undergraduates most prefer learning in the form of pre-recorded video lectures with basic explanation and deeper analysis. Our study is consistent with [12] that videos should be prepared in short blocks of time and sequences (microlearning). Educators need to change their approach to teaching and deliver concepts in shorter segments; the attention of generation Z members is given only 8 seconds. The findings of our study can be extended by other research with some tips for implementing generation Z-oriented instruction. In this context, the authors offer the following recommendations: a) Use mobile technology when possible. b) Use tasks that can be completed on tablets or phones. c) Encourage collaboration using technology. d) Reinforce concepts based on YouTube videos. e) Incorporate practical experience and illustrative examples of good practice. Our study found that the least preferred form of learning by generation Z is audio in the form of podcasts with practitioners or in the form of audiobooks.

Because generation Z, regardless of socio-demographic factors, represents a strong, sufficiently technically proficient generational cohort that feels comfortable in the online world [6], it was desirable to explore the influence of socio-demographic factors on the use of digital platforms and on preferences for forms of learning. Thus, beyond these studies, our study linked findings on preferred forms of learning and the use of digital platforms in learning by representatives of generation Z with socio-demographic factors such as gender, field of study, and form of study. The behavior of generation Z undergraduates by field of study, broken down into engineering, humanities, and economics, differs significantly in preferred forms of learning. The preferences of engineering students differ significantly from those of humanities and economics students. Engineering students prefer video learning the most, thus confirming the behavior of generation Z representatives as such [5]. generation Z is digitally literate and possesses information skills, enhancing flexibility in relation to various digital platforms for collecting, selecting, sharing, and exchanging information [5]. Our study found that engineering students least prefer podcasts or audiobooks. These findings may be related to the characteristics of the field of study, which is inherently technology-oriented, and the form of videos as a support for student learning is among the most widely used. The findings are supported by a study that strongly recommends the reinforcement of YouTube video-based concepts [30]. The results of our research and the conclusions of the above studies can be explained by another study that examines teaching and learning practices in the context of engineering education. Engineering education mainly uses laboratories in teaching, which can be divided into hands-on, virtual, and remote ones. Thus, instructional videos are more popular for engineering students than for students in economics and humanities programs because they lead to a higher learning effect [19]. Our study welcomes this learning format and makes it one of the recommendations on how to pedagogically manage the teaching and learning of generation Z students in engineering degree programs. The recommendation can be reinforced by the argument of research studies [31] that reveal that generation Z students prefer the most pre-recorded webinars (i.e., a combination of audio and video) among learning formats. Questions around the effective implementation of these forms often remain unanswered, even though these new approaches have unique and powerful parameters for enhancing the effectiveness of informal learning.

Members of generation Z primarily use online platforms for teaching and learning [31]. They are used to search for all content and information online through various digital platforms, while preferring a personalized approach and working alone.

This fact may make them less interested in current world events. This aspect may lead to their lack of understanding of what is happening in the world because they cannot put these facts into context. Students operating in this digital environment can also be often naive and believe untruthful information easily. This can be seen as one of the disadvantages of online digital learning resources. Therefore, emphasis should be placed on the development of critical thinking [32]. The development of critical thinking is well supported by the STREAMS strategy [33], which is based on using the latest developments of technology for a blended on-the-move and in-house university educational approach.

Although representatives of generation Z, regardless of socio-demographic factors, most prefer videos as a form of learning support according to our study, in terms of gender differences, women were found to prefer the audio form in the form of podcasts compared to men. Similarly, this form of learning is preferred significantly more by students of a combined form of study as compared to students of a full-time form of study. The above-mentioned findings were found out of international studies. It should be noted that the results may be related to the sample selection and its structure, as well as the country in which the research was conducted.

For generation Z students, the most critical factor is personalized learning. They perceive modern digital learning technology platforms as proving to be the best learning experience [34]. Therefore, our study also focused on the use of specific digital platforms not only during teaching but also during learning. The study shows that most Czech generation Z university students use the basic level of MS Teams for online transfer and uploading of study materials during learning. The majority of students also use formative assessment and voting platforms such as Kahoot, Sli.do, or Mentimeter to support their learning. These findings are consistent with the study [13], which concludes that self-directed learning, digital learning applications, etc. are gaining importance among generation Z. These findings are also acknowledged by the mentioned study [32]. The use of ongoing feedback with formative assessment is appropriate. Formative assessment improves students' learning outcomes and increases their autonomy for self-regulated learning [35]. According to a study [36], formative assessment is a useful tool that generates data for making decisions about appropriate instructional strategies and forms and methods for learning in technical education. The benefits of formative assessment include targeted course offerings for students, analysis of student behavior, and performance, improved course curriculum development, and personalized learning. All these aspects can be combined into a modern concept of semester and out-of-semester educational courses, or into non-formal education based on personalized learning. Informal learning has been proved by the mentioned study [37] to be a significant mode of learning for beginning undergraduates in technical or engineering degree programs.

Our study, beyond the above findings from different regions of the world, explored the use of digital platforms to support learning in relation to socio-demographic factors. The digital platforms with significant dependency, i.e., LMS Moodle, entry level MS Teams, and formative assessment and voting platforms, are most used by students of economics as compared to students of engineering and humanities. In the general context of university educational practice and the study fields pursued, the emphasis should be placed on excellence, scientific character, perspective, international dimension and collaboration, digitalization, academic and scientific reputation, knowledge dissemination, and innovation [38]. Significant differences were also found at the gender level. Men generally use digital platforms more often than women. This relationship was also found for full-time students compared to combined students.

In the international environment of engineering university education, new pedagogical approaches and experimental teaching methods are being tested and used on an empirical basis due to the influence of psychological and structural changes of generation Z. A study [39] provides an explanation of measurement through experimental observation of subjects in engineering disciplines. The method consists of breaking down–subject–spotting–a complex topic into small parts that require less sustained attention and are easier to understand and remember. A strong emphasis is placed on experimental and laboratory learning, allowing a combination of theory and practice [19]. Similarly, like in the Czech Republic, also in the international environment, the same methods for teaching gen Z are used [40]. The most common methods are project-based methods, e-learning, gamification, and Massive Open Online Courses (MOOCs) [41], [42]. Our research is in line with the mentioned methods that are supported internationally, as it has been found that students in technical programs use video formats the most for learning. This finding is in substantive agreement with the mentioned teaching methods.

There are some limitations of the study that point to additional opportunities for future research. First and foremost, there is a need to broaden the research sample in the subgroups of generation Z representatives, particularly in terms of fields of study. There is a need to focus more on the reasons for the significant differences in preferences for forms of learning and the use of digital platforms in education to support the learning of university students. This can be done with a larger sample of generation Z respondents and with including other universities relevant to the current research—mainly engineering degree programs. Universities will be selected with respect to both national and international environments. This limitation of the current study may make it difficult to generalize the results of the survey because the respondents in each group of degree programs are not comparable with regard to their number. Furthermore, the study did not take into account social factors, i.e., the interaction of feelings, social isolation, and anxiety of generation Z representatives and the need to share personal information on social networks [43], [44]. Furthermore, it would be useful to examine the use of digital platforms in the context of game elements. The implementation of gamification elements helps users to remove negative emotions, bringing them well-being and satisfaction. Gamification is a desirable approach to learning, positively influencing emotions when working with information [15].

6 CONCLUSION

The aim of this study was to investigate the influence of socio-demographic factors on the use of digital platforms and preferred forms of learning among generation Z university students from the Czech Republic. This study provides implications for the field of learning support for the current generation Z in terms of digitalization and effective engagement with technology in real-time teaching or during students' home preparation. In particular, the study has practical implications for building appropriate learning strategies reflecting the needs of generation Z representatives in the higher education environment. The results of our study suggest that a key characteristic of an appropriate educational strategy to support student learning is a variety of forms of learning materials to support learning. Research has shown that students' preferences vary in different fields of study. In the field of engineering, it is recommended to create learning materials mainly in the form of short videos, for example, based on YouTube. In order to be effective and to

demonstrate instructions, practical examples, or the use of laboratory techniques in the most effective instructive way, the video should be supplemented with multimedia and interactive elements for illustration and animation. It is recommended to create videos in the form of short sequential video segments. This can also be micro-learning. One video should not be longer than 10 minutes. It may also be appropriate to intersperse the video with a short formative quiz or test that can offer personalized learning. It will also provide formative feedback to the learner, thus enlivening their learning. All these methods can be combined when using microlearning as one form of learning through interactive video. MOOCs, for example on the Coursera, platform, are another suitable way of integrating videos, simulations, and instruction into engineering education. These online courses are available to all and free of charge. They can be integrated as a supplement to engineering education at the level of a specific subject. Courses can be tutored without tutor input, with or without a time limit. The course uses various forms of resources and learning such as video, text, or discussion forums while allowing formative tests for verification. Engineering students mainly use the MS Teams platform and also platforms that allow formative assessment, i.e., getting immediate feedback to determine their own performance and success. At the same time, these platforms allow students to express their attitudes towards the learning experience. Therefore, it is essential to incorporate self-assessment elements into university teaching as well. The study has theoretical implications for future research, especially in the social domain and the implementation of gamification elements in teaching through digital platforms. The study provides potential scope for future exploration and design of digital literacy development in engineering education, such as using specific software or navigating technical databases.

7 ACKNOWLEDGMENT

This study was funded by the research project of the internal creative support of the College of Polytechnics Jihlava 2024 No. 1170/26/115 and No. 1170/26/118. This study was supported by the research project of the Faculty of Finance and Accounting, which is realized in the framework of institutional support at Prague University of Economics and Business IP100040.

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