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HUMAN-COMPUTER INTERFACE ACCEPTANCE AMONG GENERATION Z STUDENTS

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Abstract

This paper emphasizes the importance of studying user attitudes and opinions within the field of human-computer interaction (HCI). HCI is an interdisciplinary field that deals with the design, evaluation, and implementation of interactions between people and computer systems, which is dynamically evolving with the development of information technology. Despite growing HCI adoption, challenges remain in user acceptance, privacy concerns, and accessibility. The aim of this study is to investigate the acceptance and attitudes of students (N=261) in 4 higher education institution towards HCIs using a 5 factors survey. In addition, K-means clustering was used to determine distinct user segments with varying degrees of acceptance towards HCI. The segmentation identified the primary differences in user attitudes and issues, with specific recommendations for designers, educators, and developers. The findings show that HCI acceptance and attitudes are relatively high among the students who participated in the survey. Despite challenges in HCI adoption, our findings highlight opportunities to enhance user acceptance, privacy, and accessibility.

Keywords: Accessibility, Human-computer interaction (HCI), Technology adoption, User attitudes Generation Z, User experience, User testing.

1. Introduction

Human-computer interaction (HCI) is an interdisciplinary field that deals with the design, evaluation, and implementation of interactions between humans and computer systems [1]. The field HCI is dynamically evolving with the development of information technology, and user attitudes and opinions play an important role in HCI research and technology product design [2]. User testing and interaction analysis can help identify user needs and design considerations that can contribute to improving the effectiveness of games [3]. In addition, serious games are also becoming increasingly important for HCI as they offer opportunities to explore new forms of interaction and user experience [4]. Understanding user attitudes and opinions is essential for designing effective, user-friendly, and well-received products [5]. According to the Technology Acceptance Model (TAM), users' attitudes and opinions play an important role in the adoption and use of technology products [6].

The application of TAM model helps to understand the impact of users' attitudes and opinions on the use and adoption of technology products. However, despite the growing importance of HCI, there remains a gap in understanding how different user segments, particularly Generation Z, perceive and adopt these technologies, highlighting the need for targeted investigations into their attitudes and expectations. Based on the TAM, our survey integrated its key dimensions, perceived usefulness, perceived ease of use, and technology attitudes to frame the questionnaire items and explain the patterns of acceptance among Generation Z students. Social and cultural factors also play an important role in the study of users' attitudes and opinions. Research has shown that social and cultural background influences users' attitudes and opinions and developments towards HCI [7, 8].

Moreover, studying users' attitudes and opinions helps to promote the accessibility and inclusive design of technology products, which contributes to increasing the market accessibility of technology products and promoting social equity [9]. Bodker and Klokmose emphasize that a deeper understanding of user attitudes and opinions helps to promote the accessibility and inclusive design of technology products. From their perspective, research on user attitudes and opinions contributes to increasing the market accessibility of technology products and promoting social equity.

Research on HCIs and the experiences they create has become increasingly prominent in recent years, particularly with the rise of virtual and augmented reality tools [10]. This article discusses HCI in detail, particularly virtual and augmented reality tools, and examines user experience and user attitudes towards ownership and control of humanoid avatars. This research shows that the study of user experience in HCI has become increasingly prominent in recent years, especially with the rise of virtual and augmented reality tools. The quality of interaction, user experience, and technology acceptance are strongly influenced by users' attitudes and opinions. [3].

The study of user attitudes and opinions plays an important role in the design and development of HCIs, including the application of accessibility and inclusive design principles [11]. As technology becomes more and more a part of our everyday lives, user attitudes and opinions have a significant impact on the use and adaptation of technology products [12]. Although many studies address HCI user attitudes, less is said specifically about Generation Z's views and their practical impact on design.

The aim of this paper is to examine attitudes towards HCIs among Generation Z students in higher education. Generation Z has fully grown up in the digital age and for several reasons it is important to investigate their views and attitudes towards HCIs. The purpose of the study is also relevant because Generation Z members consider technology to be a natural part of their daily lives, and their opinions and attitudes can therefore have a major impact on the design and development of technological products and services. On the other hand, they are the consumers and technology users of the future, so understanding their opinions and attitudes can help companies and developers anticipate market trends and user needs. The article pays particular attention to the attitudes and opinions of Generation Z members towards HCI.

The article maps the technology use habits, expectations and attitudes of this generation, which is particularly important given that this generation has grown up in the constant presence of digital technology. The contribution of the article is also reflected in its interdisciplinary approach, where it offers new perspectives by integrating theories of HCI and technological acceptance. This integration helps to better understand how different factors influence the user-friendly design and adoption of technology products. The specific contribution of this paper focuses on the examination of technology adoption models and attitudes and opinions of Generation Z, with a particular focus on HCI.

2. Related Works

In the field of HCIs, research on user attitudes and opinions has helped the development of technology products and services. Several studies have been conducted in this area which have contributed to the understanding of the current situation. Research on user attitudes and opinions in the field of HCI initially focused on modelling technology adaptation [13]. This line of research investigated the role of user attitudes and opinions in the adaptation and use of technology products. In addition, research on user attitudes and opinions has helped in the design and development of HCIs, including the application of accessible and inclusive design principles [9].

This line of research has been further developed to better understand how user attitudes and opinions influence the design and development of technology products. In recent years, research on user attitudes and opinions has been extended into the field of virtual and augmented reality [10]. This line of research aims to understand how user attitudes and opinions influence the application and use of virtual and augmented reality technologies. Conversely, research on user attitudes and opinions also faces a number of challenges. For example, the rapid change in user attitudes and opinions as technology evolves [14]. In this work, Rogers, Sharp and Preece highlight the rapid change in user attitudes and opinions as technology evolves.

According to the authors, this change poses a challenge for HCI research and practice, as designers and researchers need to keep up to date with changes in user attitudes and opinions. In addition, researchers often have difficulties in accurately measuring user attitudes and opinions, which are often subjective and variable [5]. The study of the technological opinions and attitudes of Generation Z are also an interested topic. Seemiller and Grace [15] showed that members of Generation Z place a high value on technology and have positive attitudes towards technology, which they explain as technology enhancing the quality and opportunities of life.

Twenge et al. [16] found that members of Generation Z often use technology in learning [17] and have a positive view of educational applications of technology.

However, research has also shown that there are digital inequalities among members of Generation Z. Hargittai and Micheli [18] found that some members of Generation Z have limited access to technology, and this may influence their attitudes and opinions about technology. Tolstikova et al. [19] focuses on the digital behavior of Generation Z, in particular on parameters such as understanding of responsibility, attitudes towards individualism and collectivism, instrumental rationality and communication skills. The study showed a sharp difference between Generation Y's perception and Generation Z's self-evaluation and explored some aspects of the interaction between Generation Z and the Internet environment.

The study found that members of Generation Y perceive Generation Z as a lower generation (poorly socialized, infantile, Internet addicted, cliquey thinking, individualistic). However, the results of the study showed that the perceptions of Generation Y's focus group about Generation Z's socialization deficits are not fully substantiated. The Pew Research Centre [20] reports that members of Generation Z are concerned about the impact of technology. They have higher expectations on HCIs, because they use highly intuitive and easy-to-use interfaces, so they are more concerned about the user experience than the average user.

Research by Prensky [21] suggests that for Generation Z, technology is essential for learning and everyday life. This generation uses technology not only for learning and work, but also for entertainment and social networking. The young generation's cognitive pattern influenced by overusing multimedia, smart devices, and tools of cognitive InfoCommunications has been described [22-24]. A rapid progress in usage of electronic devices and Internet education environments since 2019 has affected cognitive models what is mentioned in [25, 26].

Hargittai and Micheli [18] pointed out that although members of Generation Z generally have high levels of technological skills, there are still differences in digital literacy. Researchers found that there are significant differences in technology access and information literacy among members of Generation Z, and these differences may affect user experience and perceptions of the HCI. In summary, the opinions, and attitudes of Generation Z towards HCIs are variable and diverse, although they generally show positive attitudes and high technological skills. However, researchers need to continue to monitor this dynamic area to understand the needs and expectations of Generation Z and the differences in technological skills and access within this generation. Technology characteristics also play an important role in technology adoption.

Venkatesh et al. [27] stated that usability and functionality, performance and reliability all influence adoption. The better the perception of these characteristics, the more likely it is that the technology will be adopted. Environmental factors are also key. Social norms, support, and feedback systems all influence people's attitudes towards technology adoption. Social influence theory, for example, describes the extent to which individuals can be influenced by others in adopting technology. The role of technological support and feedback systems can also be identified, as supported by the UTAUT model of Venkatesh et al. [13]. The expectations also influence the adoption and use of technology. Expectations can be high about how quickly and efficiently technology can help users perform tasks [28]. These expectations can influence user opinions and attitudes towards

technology, which can affect technology adoption and use [29]. User expectations and opinions are also related to the appearance and aesthetic quality of the HCI [3].

Design elements such as information architecture, graphical elements, colour schemes, typography and navigation structure all influence the user experience and contribute to the expected use of the technology. With the application of artificial intelligence and machine learning, these systems will become increasingly able to tailor the user experience and better understand the user's needs. Another important direction of development is immersive technologies together with HCI such as virtual reality (VR) and augmented reality (AR) [30, 31].

These technologies are increasingly integrated into everyday life and offer new ways to interact and process information [32]. Ethical issues will also play an important role in the future development of HCIs. In this context, research is being conducted on issues related to privacy, decisions made by Artificial intelligence (AI), robotics, education, and trust in technological systems [33-36]. The teaching of topics supported by robots [37] can be implemented in a modern, interactive way, which greatly supports the informal learning dimension [38] and the process of learning through group work [39]. This also contributes significantly to the development of students' digital competences [40].

3. Methods and Material

Based on the literature review described above, we developed 25 items web-based public questionnaire survey. The survey questions were validated by an expert group, and their reliability was assessed through the analysis presented in section 4.2 Reliability Analysis. The design of a web-based survey was chosen to measure the attitudes towards HCIs by five factors. On average, it took seven minutes to complete the survey.

The survey was conducted in spring 2023.The questionnaire was pre-tested on a small group of students, and based on the feedback, some questions were clarified, reworded, or omitted. Based on this, the final questionnaire was developed, which contained 25 questions in a 5-factors, as well as other demographic questions. The structure of the questionnaire is shown in Table 1. A 5-point Likert scale applied for almost all items (1 = I completely disagree; 2 = I slightly disagree; 3 = I am neutral; 4 = I slightly agree; 5 = I completely agree).

The questionnaire was web-based, providing convenience sampling of the target population of students. For data analysis, IBM SPSS Statistics 29 was used with a significance level of $p < .05$, standardization in K-means clustering, and factor reliability tested with Cronbach's alpha to facilitate replication of the procedures. The five factors - General opinions about new IT, Opinions about new HCI developments, Expectations on HCI developments, Threats on HCI developments, and Legal regulations on HCI developments - were taken from both the Technology Acceptance Model (TAM) and from current HCI literature.

For example, under "Expectations on HCI developments," an item is "I believe that future HCI solutions will significantly improve my daily tasks," and under "Threats," an item is "I am afraid of possible privacy intrusion when using new HCI technologies." This procedure aligns each factor with a sound theoretical basis, which helps guarantee the reliability and validity of the survey.

Table 1. Structure of the questionnaire. (*N* = 261)

Factors	Number of items
General opinions about new IT	5
Opinions about new HCI developments	5
Expectations on HCI developments	5
Threats on HCI developments	5
Legal regulations on HCI developments	5

3.1. Participants

The participants of the study were 261 computer, electrical and mechanical engineering, logistics, teacher students at University of Dunaujvaros, Obuda University, Eszterhazy Karoly Catholic University and John von Neumann University, Hungary. Figures 1 and 2 show the distribution of students by study program and age. Most of the students are in Generation Z (76%).

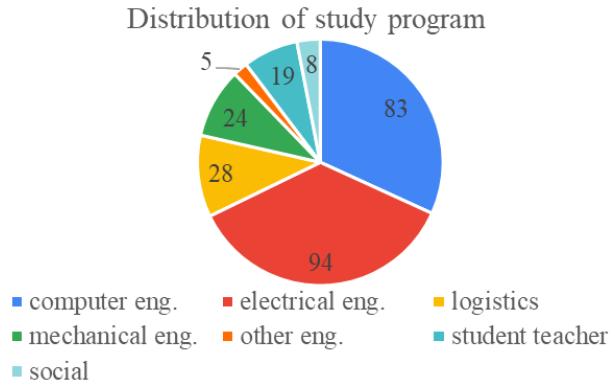

Fig. 1. Distribution of students based on the study program.

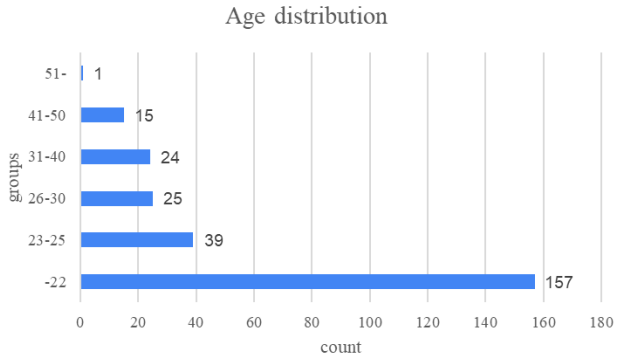

Fig. 2. Distribution of students by age.

3.2. Analysis

In line with the exploratory nature of the study, we decided to use descriptive and analytical statistics to interpret our results. Descriptive statistical analysis of the results is summarized in Table 2. Mean and standard deviation was calculated for each factor. Table 3 shows the Cronbach' s alphas of all scales and the values are

between .76 to .92. These values meet the criteria indicating reasonable reliability in social science Cronbach alpha > .60 [28]. A correlation matrix was used to examine the relationships between the factors of opinions about HCI. The Shapiro-Wilk test was used to check the normality of the distributions. To assess the statistical significance of the correlation, Pearson correlation is used for approximately normal distributions and Spearman correlation for non-normal distributions. K-means clustering was used to classify students into groups. T-test was applied to compare the clustered groups.

4. Results

The next chapters summarize the results of descriptive statistics, reliability analysis and correlation matrix.

4.1. Descriptive statistics

Table 2 shows the descriptive statistics of the five factors of the questionnaire.

Table 2. Descriptive statistics. (*N* = 261)

Variables	Min	Max	Mean	SD
General opinions about new IT technologies	2.40	5.00	3.68	0.66
Opinions about new HCI developments	2.00	5.00	3.72	0.71
Expectations on HCI developments	2.40	5.00	3.82	0.60
Threats on HCI developments	2.40	5.00	3.73	0.60
Legal regulations on HCI developments	2.40	5.00	4.15	0.59

The results show that the average score for each factor is above 3.5, with the highest average score for the Legal regulations on HCI developments factor being 4.15. This highlights the importance of legal regulations.

4.2. Reliability analysis

Table 3 shows the results of the reliability analysis based on internal consistency. The results show that the reliability of the sets of questions characterizing the factors of the survey is acceptable.

Table 3. Cronbach's Alphas for factors. (*N* = 261)

Factors	Number of items	Cronbach's Alphas
General opinions about new Information technologies (IT)	**5**	**0.80**
Opinions about new HCI developments	**5**	**0.83**
Expectations on HCI developments	**5**	**0.84**
Threats on HCI developments	**5**	**0.81**
Legal regulations on HCI developments	**5**	**0.82**

4.3. Associations between different factors

The correlation matrix shows the correlations between the factors studied. Table 4 shows the results of the Shapiro-Wilk normality test and concludes that the data are not normally distributed. Table 4 shows the results of the normality test, and it can

be concluded that data are not normally distributed. Table 5 shows the results of correlations calculated by Spearman calculation.

Table 4. Shapiro-Wilk test of normality. (*N* = 261)

Variables	W-value	p-value
General opinions about new IT technologies	0.977	<0.001*
Opinions about new HCI developments	0.977	<0.001*
Expectations on HCI developments	0.981	0.001*
Threats on HCI developments	0.981	0.001*
Legal regulations on HCI developments	0.947	<0.001*

*Since the p-value is less than 0.05, the data does not appear to be normally distributed.

Table 5. Correlation matrix of factors. (*N* = 261)

Variable	1	2	3	4	5
1 General opinions about new IT technologies	1	0.865*	0.670*	-0.573*	0.506*
2 Opinions about new HCI developments	0.865**	1	0.438*	-0.569*	0.473*
3 Expectations on HCI developments	0.670**	0.438*	1	-0.274*	0.339*
4 Threats on HCI developments	-0.573**	-0.569*	-0.274*	1	-0.271
5 Legal regulations on HCI developments	0.506**	0.473*	0.339*	-0.271*	1

**Correlation is significant at the 0.01 level (2-tailed).

The results show positive significant associations between General opinions about new IT technologies and Opinions about new HCI developments ($r[12] = 0.865$, $p = 0.01$). We found positive moderate associations between General opinions about new IT technologies and Expectations on HCI developments ($r[13] = 0.670$, $p = 0.01$) and Legal regulations on HCI developments ($r[15] = 0.506$, $p = 0.01$). On the other hand, there is negative moderate relationship with lack of self-confidence in programming ($r[14] = -0.573$, $p = 0.01$). A similar result can be observed on Expectations on HCI developments and Legal regulations on HCI developments vs other factors but with moderate or weak correlation values.

4.4. K-means clustering

The K-means clustering method was used to create groups of students based on the results obtained for the factors. The input data of the K-means algorithm was standardized and the maximum number of iterations of the algorithm was set to 10. The algorithm run converged in 7 iterations. Multiple solutions evaluated by comparing within-cluster variance and the interpretability of the resulting segments. Ultimately, the chosen cluster solutions showed the clearest distinctions in acceptance levels and concerns about HCI. The number of individuals in the clusters and the final cluster centres are summarized in Tables 6 and 12 with 3 and 4 clusters. The ANOVA results for the factors show significant differences between the clusters (groups) formed, as shown in Table 8.

Table 6. Number of cases in each cluster (3).

Cluster	1	80
	2	98
	3	83
Valid		261
Missing		0

Table 7. Final cluster centres (3).

	Cluster		
	1	**2**	**3**
Zscore: General opinions about new IT technologies	1.143	-0.055	-1.037
Zscore: Opinions about new HCI developments	1.135	-0.145	-0.923
Zscore: Expectations on HCI developments	0.738	0.123	-0.857
Zscore: Threats on HCI developments	-0.788	-0.058	0.829
Zscore: Legal regulations on HCI developments	0.692	0.133	-0.823

Table 8. Results of ANOVA for the final clusters (3).

	Cluster		Error		F	Sig.
	Mean Square	**df**	**Mean Square**	**df**		
Zscore: General opinions about new IT technologies	97.063	2	0.255	258	380.146	0.000
Zscore: Opinions about new HCI developments	87.864	2	0.327	258	268.994	0.000
Zscore: Expectations on HCI developments	52.987	2	0.597	258	88.756	0.000
Zscore: Threats on HCI developments	53.499	2	0.593	258	90.214	0.000
Zscore: Legal regulations on HCI developments	48.101	2	0.635	258	75.765	0.000

Figure 3 bar graphs show the characteristics of the three clusters defined by the K-means algorithm with respect to each factor, with the deviation from the cluster centres displayed and summarized in Table 9. Cluster 1 (N=80) is the cluster of students with above average acceptance and cluster 3 (N=83) is the cluster of students with below average acceptance. Therefore cluster 1 is the opposite of cluster 3 typically. Cluster 2 (N=98) who have a neutral opinion.

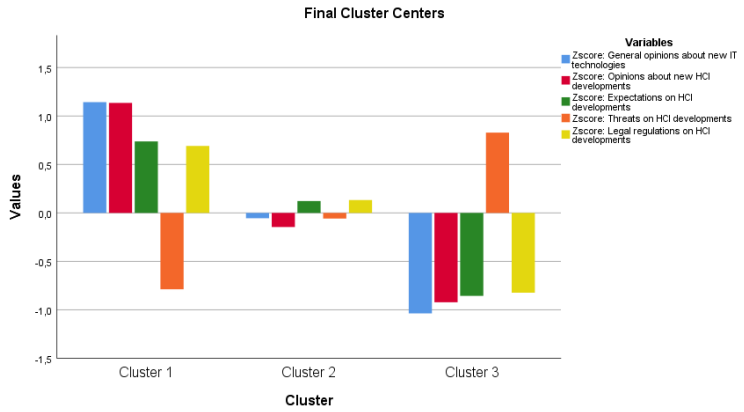

Fig. 3. Final cluster centres vs Cluster 1, 2 and 3.

Table 9-12 summarize the distribution of student based on the Cluster 1 and 2.

Table 9. Student distribution by cluster 1, 2 and 3.

Variables	Cluster 1	Cluster 2	Cluster 3
computer Eng.	14.2%	13.8%	3.8%
electrical Eng.	10.0%	14.6%	11.5%
logistics	1.9%	3.1%	5.7%
mechanical Eng.	2.7%	2.3%	4.2%
other Eng.	0.8%	0.4%	0.8%
student teacher	0.8%	3.1%	3.4%
social	0.4%	0.4%	2.3%

Table 10. Number of cases in each cluster.

Cluster	**1**	51
	2	89
	3	75
	4	46
Valid		261
Missing		0

Table 11. Final cluster centres.

	Cluster			
	1	**2**	**3**	**4**
Zscore: General opinions about new IT technologies	-0.847	0.033	1.191	-1.065
Zscore: Opinions about new HCI developments	-0.855	-0.020	1.169	-0.918
Zscore: Expectations on HCI developments	-0.431	0.112	0.803	-1.048
Zscore: Threats on HCI developments	1.172	-0.297	-0.755	0.506
Zscore: Legal regulations on HCI developments	0.227	0.046	0.719	-1.513

Table 12. Results of ANOVA for the final clusters.

	Cluster		Error		F	Sig.
	Mean Square	**df**	**Mean Square**	**df**		
Zscore: General opinions about new IT technologies	65.070	3	0.252	257	258.114	0.000
Zscore: Opinions about new HCI developments	59.534	3	0.317	257	187.972	0.000
Zscore: Expectations on HCI developments	36.493	3	0.586	257	62.307	0.000
Zscore: Threats on HCI developments	44.132	3	0.497	257	88.884	0.000
Zscore: Legal regulations on HCI developments	48.953	3	0.440	257	111.199	0.000

Figure 4 bar graphs show the characteristics of the four clusters defined by the K-means algorithm with respect to each factor, with the deviation from the cluster centres displayed and summarized in Table 13. Cluster 3 (N=75) is the cluster of students with above average acceptance similar to Cluster 1 in 3-cluster result. Cluster 4 (N=46) is the cluster of students with below average acceptance similar to Cluster 3 in 3-cluster result. Cluster 1 and Cluster 4 are very similar, the difference is in aspects 4 and 5, which are "Threats on HCI developments" and "Legal regulations on HCI developments". They are the ones who are more afraid

of the legal problems and threats posed by technology. Cluster 2 (N=89) who have a neutral opinion.

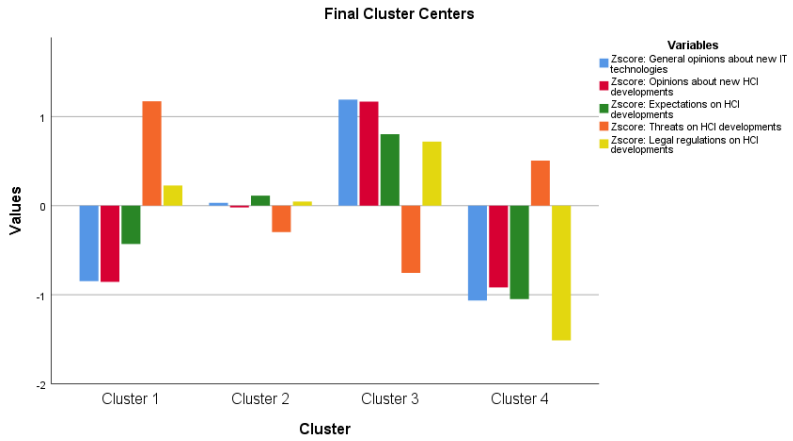

Fig. 4. Final cluster centres vs Cluster 1, 2, 3 and 4.

Table 13 summarize the distribution of student based on the Cluster 1 and 2.

Table 13. Student distribution by cluster 1, 2, 4 and 4.

Variables	Cluster 1	Cluster 2	Cluster 3	Cluster 4
computer Eng.	2.7%	14.9%	13.0%	1.1%
electrical Eng.	8.8%	11.5%	9.6%	6.1%
logistics	2.7%	1.9%	1.9%	4.2%
mechanical Eng.	1.5%	2.3%	2.7%	2.7%
other Eng.	0.4%	0.8%	0.4%	0.4%
student teacher	1.5%	2.3%	0.8%	2.7%
social	1.9%	0.4%	0.4%	0.4%

The extended dataset now includes the results of a 4-cluster solution in addition to the previous 3-cluster solution using the K-means clustering method. The additional cluster will help to refine the segmentation and provide deeper insights into the variability and specificity of student opinions on new IT technologies and HCI developments. The distribution of students across the four clusters (51, 89, 75 and 46 students) continues to show a relatively balanced segmentation, which is key to ensuring that each cluster is representative and statistically valid. The final cluster centres of the 4 cluster solution (Table 11) reveal nuanced differences between the groups of learners. For example, cluster 3 appears to aggregate learners with positive attitudes towards IT and HCI (similar to cluster 1 in the 3-cluster analysis), while cluster 4 aggregates those with negative attitudes, similar to cluster 3 in the previous 3 clusters. attitudes.

The distribution of students by field of study (Tables 9 and 13) provides further context. Suggesting that students' academic disciplines influence their perspectives on technology, this finding is consistent with the intuitive expectation that one's field of study will influence their technological outlook. The variation in the percentage of students from different engineering disciplines and from other fields within each cluster suggests that the integration of technological perceptions may

be influenced by the specific content and focus of their academic training. When comparing the 3-cluster and 4-cluster solutions, it is noteworthy that the 4-cluster solution provides a more detailed understanding of student opinions, particularly in distinguishing between concerns about legal issues and technological threats. The distinction between Cluster 1 and Cluster 4 in the 4-cluster solution highlights the specificity of concerns about legal and threat issues, suggesting that a subset of students who, despite potentially recognising the benefits of HCI and IT developments, are particularly wary of their potential downsides.

5. Discussion

The analysis of data emphasizes how Generation Z's attitudes and expectations have a big influence on advances in HCI. Given the high degree of technological integration and digital competency exhibited by this generation, new HCI developments need to be not only creative but also simple to integrate and modify into their everyday lives and educational procedures. According to general perceptions of new IT technologies, acceptance and user attitudes indicates that perceived usefulness, ease of use, and external control factors significantly influence technology adoption [41]. As a result, technology developers must design HCI solutions with user-friendly interfaces that seem safe and effective to users.

Users are genuinely interested in innovative HCI developments, particularly if they enhance the quality and experience of digital interactions, as evidenced by their feedback on recent developments in HCI and expectations for future improvements. This is especially important in domains where innovations in HCI can create new opportunities, like education and the workplace [42]. Developers must focus more on ethical and data security issues due to concerns about threats in HCI developments and the significance of legal regulations.

Concerns from users regarding privacy and data security make these topics crucial areas of attention for upcoming HCI projects [43]. A passionate interest and proactivity in IT tools and innovations is increasingly essential in the field of human-machine relations. People with such attitudes are often more open to change and more willing to accept and adapt to new technologies. Human-machine relationships are particularly important in situations where the use of devices can significantly change the user's life, for example with smart homes or artificial intelligence applications. A positive attitude towards technology allows users to exploit these technologies and maximize their benefits [44]. Technologically proactive people are often able to learn new skills and techniques, adapt quickly to new environments, and are willing to experiment with new tools and technologies.

By trying out new input tools and technologies, the person expresses not only an interest in novelty, but also a desire to learn and an openness to challenges. A proactive attitude and interest in new things drive innovation and technological development. Finally, a passionate interest in IT tools and novelty and proactivity suggests a positive attitude and optimism for the future of human-machine relations [45]. The rapid development of technology offers incredible opportunities and those who are open and willing to try new technologies will be the first to experience these opportunities.

The analysis showed a positive significant relationship between "General opinions about new IT technologies" and "Opinions about new HCI developments".

However, a moderate relationship was found between "Expectations on HCI developments" and "Legal regulations on HCI developments". Interestingly, a negative moderate relationship was found between "General opinions about new IT technologies" and "Threats on HCI developments". These results show that users' attitudes and opinions about HCI and IT technologies generally have a positive impact on their expectations about HCI developments and their perceptions of legal regulations.

On the other hand, those who have a generally negative view of new IT technologies tend to have negative views of the risks associated with HCI developments. The K-means clustering method was used to organize students into groups based on the variables. Two distinct groups were found: the first group (N=131) is the group of students with below average acceptance, while the second group (N=130) is the group of students with above average acceptance. The results show that trust in HCI is not yet complete, if the interface does not meet the desired functionality, reliability, or usability, it may disappoint.

Privacy issues may also arise when using HCIs. There is also an emerging fear in the results that HCIs can read information that users do not want to share, such as biometric data, personal data, or sensitive business information. In addition, misuse by HCIs, such as unauthorized use of user data or misuse of data, can seriously affect user trust and adoption of technology. Although HCI technologies are constantly evolving, the action mediated by the HCI may not be what the user wants. Problems associated with HCI include complexity of interactions and user interface design, inadequate feedback, inadequate error handling, and undesired user interface behavior.

The future development directions for HCI are diverse and exciting. Both the rapid advances in technology and the proliferation of research are driving the development of new and improved HCIs. One key area is the development of adaptive and context-aware systems. This includes systems that are able to understand and respond to the user's emotional state, physical activities, and the environment. Based on these results, two groups with different attitudes can be identified among the students: the less accepting and the very accepting groups. Both groups are significant, and it is important to understand what factors determine their attitudes.

For example, their professional background may influence their attitudes towards technology. Students in computer science and electrical engineering are more accepting of new IT technologies and HCI developments than students in logistics, mechanical engineering, and other engineering disciplines. It is also important to highlight that the results show that the students in the study were generally positive about HCI developments, which means that they are optimistic about future technologies. This also suggests that they have the potential to play an active role in shaping and using new technologies.

The results do not only portray Generation Z attitudes but also provide actionable recommendations for HCI technology design and implementation. Firstly, designers can use the uncovered acceptance clusters to prioritize user-friendly, intuitive interfaces and strong data protection—elements that play a critical role in trust. Secondly, developers should adapt solutions to various motivational and ability-level profiles, promoting accessible and inclusive HCI implementations. By operationalizing our cluster findings into actionable design

guidelines, stakeholders can maximize technology uptake and user satisfaction in various educational and professional environments.

These results show the depth and variety of Generation Z members' opinions and values. Those who design and produce technology products and services as well as in the development of technology education and policy have to take into account these several points of view. Strong favourable correlations (between perspectives on HCI developments and general attitudes toward new IT) point to Generation Z's main search for dependable, simple-to-use technologies suited for their daily routines. This outcome underlines the need of perceived usefulness and simplicity of use, which is in line with other studies on the acceptance of technology by digital natives.

Emphasizing open data policies and user-friendly interfaces will help developers to leverage these insights and satisfy Gen Z consumers' high expectations. Our studies reveal that Gen Z has major privacy issues, which implies that legislation such as the GDPR will significantly affect future HCI by demanding open data practices. Respecting these legal responsibilities will boost user confidence, which will finally help to promote new HCI solutions in more general acceptance. This conclusion aligns with previous studies, which emphasize that Generation Z prioritizes ease of use, security, and trust in technology adoption, reinforcing the need for user-friendly and privacy-focused HCI solutions [46].

6. Conclusions

This paper discusses the attitudes and opinions of students representing Generation Z related to HCI and with regard to technology adoption and use. Technological attitudes and opinions further influenced socio-cultural and educational background. The article manifest that members of the Generation Z have a high level of technological acceptance with positive attitudes of technologies influencing their interaction and expectations in respect to HCI.

The research findings suggest that data protection and reliable system design are critical for Gen Z users, and that HCI solutions should be developed in a transparent manner. Intuitive, easy-to-use interfaces increase acceptance, while a differentiated approach based on cluster analysis (more accepting vs. cautious groups) is needed: for example, more information or training materials can improve trust for the more cautious group.

Developers should be diligent in addressing and communicating their position on ethical considerations, particularly with regard to potential threats and legal regulations related to HCI. Developing a clear ethical framework and guidelines can help alleviate concerns and demonstrate a developer's commitment to responsible technology adoption. Considering the different clusters and their unique characteristics, developers should ensure that HCI technologies are adapted to different user scenarios. This adaptability can increase the relevance and attractiveness of the technology among different user groups, according to a wide range of preferences and expectations.

Given the distinct segments identified through clustering, targeted promotional and awareness-raising campaigns can be effective. Informing potential users about the benefits, functionalities, and security features of new HCI technologies can address misconceptions and stimulate interest. In HCI design and development,

understanding user needs and preferences, as well as attitudes towards technology products, helps developers to create better products.

The findings point out several additional research avenues. On the one hand, it would be valuable to investigate more closely the impact of various majors and sociocultural backgrounds on attitudes towards HCI, and on the other, it is recommendable to pursue motivational differences between rejecters and acceptors of the technology. Furthermore, additional methodological development, e.g., the use of more qualitative interviews, can open up new possibilities to gain a deeper insight into user behaviour. Therefore, the findings of the current study are also appropriate to stimulate and inform future research in HCI design and adoption. These findings guide future HCI design for Generation Z by emphasizing intuitive, secure interfaces and transparent data practices. Prioritizing user-friendly features, tailored tutorials, and open communication on privacy can enhance Gen Z's acceptance and engagement.

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