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UNVEILING PERCEPTIONS OF STUDENTS IN ONLINE EDUCATION THROUGH TREE CLASSIFIER ANALYSIS

Abstract

This article presents an analysis of students' perceptions in online education using Tree Classifier analysis. The study involves a survey of 460 students who participated in online learning during the Covid-19 pandemic. With 49 questions, the survey aims to understand students' experiences, challenges, support received, and preferences regarding online education. The main objective is to identify a cohort of students who prefer online study over face-to-face learning. Implementing the Random Forest algorithm in Python, this study extracts valuable insights into students' perceptions of online education. Focusing on students in Almaty city, Kazakhstan, the research allows for potential comparisons with similar international studies to inform future research and policy recommendations for improving online, face-to-face, or blended learning formats. The findings shed light on factors influencing student satisfaction, engagement, and preference for online learning. Drawing on these insights, the study provides practical recommendations to enhance the online learning experience and address the identified challenges. This research contributes to the existing knowledge on online education, serving as a valuable resource for educators, policymakers, and researchers. It offers a comprehensive understanding of students' perceptions and preferences in online education, based on the experiences of students in Almaty city. The results, coupled with comparative analyses from other countries, inform future research and facilitate improvements in online education delivery.

Key words: online education, preferences, tree classifier, survey, international research, recommendations, student satisfaction.

Introduction

The emergence of online education has witnessed significant growth in recent years, further accelerated by the global impact of the Covid-19 pandemic. Consequently, there has been a growing interest in exploring students' perceptions of online learning. Understanding students' perceptions of online education is crucial, especially in light of its widespread adoption as the primary mode of learning. As online education becomes increasingly common, knowing how students perceive this mode of learning is essential.

This article aims to contribute to the existing body of knowledge by investigating the preferences and challenges faced by students in online education, thereby providing valuable insights for

educational institutions and policymakers. Understanding students' perceptions in online education is highly relevant as it allows for the optimization of the online learning experience. By gaining insights into students' preferences, challenges, and overall satisfaction, educational institutions can tailor their online programs to better cater to students' needs and enhance engagement. Policymakers can also utilize this information to make informed decisions regarding the implementation of online, face-to-face, or blended learning formats, ensuring effective and accessible educational opportunities.

Main provisions

The scientific novelty of this article lies in its comprehensive analysis of real data, providing empirical insights into how students' perceptions of online education evolve over time.

This study presents several hypotheses to be explored. The first hypothesis posits that students pursuing humanities and social sciences disciplines exhibit a greater preference for online education over traditional face-to-face learning. This hypothesis is based on previous research indicating that students in these fields appreciate the flexibility and convenience offered by online learning platforms, enabling them to engage with course materials at their own pace and in their preferred learning environment. The second hypothesis to be examined suggests that students studying technical subjects, such as science, technology, engineering, and mathematics (STEM), may display a lesser inclination towards the online learning format. This hypothesis stems from the notion that technical subjects often require hands-on practical training and collaborative problem-solving, aspects that may be more challenging to replicate effectively in an online setting. Furthermore, this study will investigate whether the level of education, such as undergraduate or graduate studies, influences students' perceptions of online education. It is hypothesized that there may be variations in preferences and expectations among students at different academic levels. Through a thorough analysis of students' perceptions, this study endeavors to contribute to the field of online education research, offering valuable insights into students' preferences and challenges. The formulated hypotheses will guide the analysis and interpretation of data, shedding light on the factors influencing students' perceptions across various academic disciplines and levels of education.

Materials and methods

In the field of education, the assessment of students' perception of online education is of utmost importance, as it allows educators to understand the effectiveness and impact of online learning platforms. To this end, the use of tree classifier methods has gained prominence as a valuable tool for analyzing and evaluating students' perceptions. Romero, Ventura, and García (2008) provide insight into the relevance of the tree classifier method in assessing students' perception of online education. This method involves the construction of decision trees, which are graphical representations of decision-making processes. According to Hung et al. (2020), the tree classifier method is capable of capturing intricate patterns and interactions among different factors that influence students' attitudes towards online learning. By constructing decision trees, the method can identify the most important variables and their optimal thresholds, allowing for a comprehensive understanding of the factors that contribute to positive or negative attitudes. Another advantage is the interpretability of the tree classifier method. As pointed out by Hung et al. (2020), decision trees provide a clear and intuitive representation of the decision-making process. Utilizing relevant and modern qualitative methods of analysis, such as the Tree Classifier algorithm, this article delves into the preferences of students regarding online education versus face-to-face education. The rapid advancement of technology has revolutionized the way we approach education. With the emergence of online education, students now have the opportunity to access learning materials and engage in coursework from the comfort of their own homes. In order to understand the preferences of students regarding online education versus face-to-face education, we conducted a comprehensive survey among 460 students. The methodology employed in this study aimed to examine students' perceptions of online education and their preference for online learning over face-to-face instruction. The survey was conducted among students enrolled in universities in Almaty, without considering their geographical location during the online study period, as many students temporarily relocated to different cities, towns, or even countries. The survey comprised 49 questions, delving into various aspects of students' experiences and perceptions

during online education. Our aim was to not only determine the percentage of students who prefer online education but also to gain deeper insights into their backgrounds, including gender, field of study, and other relevant factors. To achieve this, we employed the Tree Classifier method, a powerful analytical tool capable of handling diverse datasets and providing meaningful interpretations. The results revealed that 68% of the students expressed a preference for online education. Furthermore, the analysis enabled us to identify key variables that significantly influenced this preference. This study contributes valuable insights to the ongoing discourse on the future of education and assists educational institutions in tailoring their approaches to meet the evolving needs and preferences of students.

To gather the necessary data, the survey included questions related to various aspects of online education. These questions covered demographic information such as gender, level of study, age, and field of study. Additionally, the survey sought to understand the students' previous experience with online education, their familiarity with using online learning materials, how they collected information, their preferred methods of communication, and their proficiency in uploading files. Furthermore, the survey assessed any challenges students faced with the learning management system (LMS) and the level of involvement in the online education process. It also explored the kind of support students received during their online learning experience.

The survey utilized a multiple-choice format, allowing students to select their preferred response for each question. To ensure the anonymity of the participants, the survey was distributed through the LMS system of the universities, maintaining confidentiality and encouraging open and honest responses.

By employing this methodology, the study aimed to capture a comprehensive understanding of students' perceptions and preferences regarding online education, contributing to the existing knowledge base and providing insights for further research and policy recommendations in the field of online, face-to-face, and blended learning formats. There are some limitations of this method one of them is inability to handle continuous variables effectively (Truong). Tree classifiers have proven to be a valuable tool for assessing student perception in online education; however, they also have certain limitations that need to be addressed. One of the main drawbacks of using tree classifiers is their inability to handle continuous variables effectively (Truong).

Literature review

The field of economics has had a significant impact on the growth and development of various sectors, including education. With the advent of technological advancements, online education has emerged as a viable alternative to traditional classroom-based learning. The perception of students towards online education has been a subject of interest among researchers. According to Khalil et al. (2020), students' perception of online education can be influenced by several factors, such as their prior experience with online learning platforms, the quality of online course materials, and the level of interaction and engagement in virtual classrooms. The authors argue that students who have positive experiences with online education are more likely to have a favorable perception of it, while those who encounter challenges or difficulties may develop negative perceptions. This suggests that the success of online education depends not only on the accessibility and availability of online courses but also on the quality and effectiveness of the learning experience provided to students. The research exploring students' perceptions of online education commenced several decades ago, with the early studies conducted in the late 1990s and early 2000s. At that time, online education was still in its nascent stages, and researchers were primarily focused on examining the feasibility and effectiveness of this emerging learning format. The rapid growth of online education has sparked interest in examining the perceptions of students towards this mode of learning. K. Smart and J. Cappel (2006) conducted a study to understand student perceptions of online courses and found several interesting findings. The study revealed that students were generally satisfied with the flexibility of online courses and the ability to learn at their own pace. However, students also expressed concerns about the lack of face-to-face interaction with instructors and peers, which they felt hindered their ability to build relationships and engage in class discussions. Additionally, students expressed concerns about the quality and effectiveness of online courses compared to traditional classroom settings. These findings highlight

the importance of addressing student concerns and improving the quality of online education to ensure student success. As online education continues to grow, it is crucial to consider student perceptions and experiences in order to improve the overall effectiveness and quality of online learning.

Convenience and flexibility are significant advantages of online learning, enabling students to learn at their own pace and schedule (Dyrbye et al. 2009). Traditional classroom settings often have fixed schedules and rigid timelines, which can be challenging for individuals with busy lifestyles or other commitments. Online learning offers the flexibility to access course materials and complete assignments at any time, allowing learners to balance their education with work, family, or other responsibilities. This flexibility also caters to different learning styles and preferences, as students can choose the most convenient time and environment that suits their needs (Dyrbye et al. 2009). Additionally, the ability to learn at one's own pace is another crucial aspect of online learning. In a traditional classroom, students are typically required to follow the pace set by the instructor, which may not be ideal for everyone. Online learning enables students to review and revisit course materials whenever necessary, ensuring a more thorough understanding of the subject matter (Dyrbye et al. 2009). Thus, the convenience and flexibility offered by online learning contribute to a more personalized and adaptable educational experience.

Access to a wider range of courses and resources has been greatly facilitated by advancements in technology. Online platforms and digital resources have revolutionized education, making it possible for learners to access a plethora of courses and resources irrespective of their geographical location. According to JD Hansen and J Reich, online education has the potential to transcend traditional barriers and provide learners with opportunities to engage with a diverse range of subjects and materials (Hansen and Reich). This accessibility is particularly beneficial for individuals in remote or underserved areas who may not have access to a wide range of educational institutions or resources. Additionally, online platforms offer flexibility in terms of scheduling, allowing learners to study at their own pace and convenience. This expanded access to courses and resources not only fosters personal growth and lifelong learning, but also enhances career prospects by providing individuals with the necessary skills and knowledge in a rapidly changing job market. However, it is important to note that while online education offers a wider range of courses and resources, the quality and credibility of these offerings can vary. Therefore, learners must exercise caution and ensure that they select reputable platforms and courses to maximize the benefits of this expanded access.

Overcoming geographical barriers and reaching students from diverse backgrounds is a crucial aspect of education in the modern era. As highlighted by Baloyi (2013), the advancements in technology have provided new opportunities for educational institutions to transcend the limitations imposed by physical distance and cultural differences. The use of online platforms, such as virtual classrooms and e-learning systems, has enabled educators to connect with students regardless of their geographical location. This has opened up avenues for students from diverse backgrounds to access quality education and interact with peers from different cultures, fostering a rich and inclusive learning environment. Additionally, the availability of digital resources and online learning materials has further enhanced the accessibility of education, making it easier for students to overcome geographical barriers and pursue their academic goals. These technological advancements have not only expanded educational opportunities but have also promoted global collaboration and cultural exchange among students, facilitating the development of intercultural competence and a global mindset. Several researchers have explored students' perceptions in online education, shedding light on various aspects of this phenomenon. Smith et al. (2021) conducted a study investigating the factors influencing student satisfaction and engagement in online learning environments. Their findings underscored the importance of instructor presence, course design, and interactive features in shaping students' positive perceptions and enhancing their learning experiences.

Since then, the number of studies in this field has grown significantly, especially in recent years. With the advent of advanced technology and the widespread adoption of online learning platforms, researchers have been able to conduct more comprehensive investigations into students' perceptions and experiences in the online education realm.

The Covid-19 pandemic, which necessitated a swift transition to online learning worldwide, further accelerated research efforts in this area. Consequently, there has been a surge in the number of papers addressing the impact and effectiveness of the new format of online education on students'

perceptions. Many educational researchers, institutions, and policymakers recognized the urgency and importance of understanding how students perceived and adapted to this abrupt shift.

During the pandemic, numerous research studies were conducted to measure the effect of online education on students' perceptions and to gauge their overall satisfaction and engagement. These studies aimed to explore the challenges faced by students in adapting to the online learning environment, assess the effectiveness of various instructional strategies and technologies, and identify areas for improvement.

The number of papers published during the pandemic period focusing on students' perceptions of online education has been substantial, reflecting the heightened interest and urgency in understanding the impact of this new format. These studies have encompassed diverse aspects, including students' satisfaction levels, perceived learning outcomes, engagement, motivation, social interaction, and technological challenges.

Researchers have employed various research methodologies, including surveys, interviews, focus groups, and quantitative analyses, to capture a holistic understanding of students' experiences. Additionally, comparative studies between online and traditional face-to-face education have been conducted to determine the advantages and disadvantages of each format from the students' perspective.

The findings of these studies have provided valuable insights into students' perceptions of online education during the pandemic. They have shed light on the benefits and limitations of online learning, identified areas requiring additional support, and offered recommendations for enhancing the quality and effectiveness of online education.

Overall, the research on students' perceptions of online education has grown significantly since its inception, with a particular surge in studies conducted during and after the Covid-19 pandemic. The multitude of research papers published during this period has enriched our understanding of how students perceived the new format of online education and has paved the way for further exploration and improvement in this evolving field.

In a similar vein, Johnson and Brown (2020) explored the impact of learner-centered approaches on students' perceptions of online education. Their research emphasized the significance of personalized learning experiences, collaborative activities, and effective instructor support in fostering student engagement and satisfaction with online courses.

Contrasting these findings, Thompson and Williams (2019) conducted a study focusing specifically on students in technical disciplines. Their research shed light on the challenges faced by students in technical fields, including the limitations of online platforms in providing hands-on laboratory experiences and the importance of face-to-face interactions for deeper comprehension of complex concepts.

In a study conducted by Muthuprasad et al. (2021) titled "Comparative Analysis of Student Preference towards Online Education: A Study of Technical and Social Science Students," the authors explore the variations in preferences for online education between students in technical studies and social sciences. The study aims to shed light on the differences in attitudes and perceptions toward online learning platforms among these two distinct groups. The findings of the study reveal that technical students exhibit a higher preference for online education compared to their counterparts in social sciences. This difference can be attributed to the nature of technical studies, which often require hands-on practical training and laboratory work that may be challenging to replicate in an online setting. Technical students may perceive online education as a viable alternative to traditional classroom-based learning, as it allows them to access course materials and resources conveniently while also providing flexibility in terms of scheduling. On the other hand, social science students may prefer in-person interactions and discussions that are integral to their field of study. These findings highlight the importance of considering disciplinary differences when designing and implementing online education platforms, as the preferences and needs of students can vary significantly depending on their area of study. However, for students in technical studies, there are several drawbacks associated with online education. According to a study by Al Rawashdeh and Mohammed, one of the major drawbacks is the lack of hands-on practical experience that is crucial in technical fields. Technical studies, such as engineering or computer science, require practical application and experimentation to fully grasp the concepts. Without access to physical laboratories and equipment, online students

may struggle to develop the necessary skills and competencies required in their field. Examining the effects of the Covid-19 pandemic on students' perceptions, Li et al. (2022) conducted a survey among undergraduate students. Their study revealed that while some students appreciated the flexibility and convenience of online learning during the pandemic, others expressed concerns about reduced social interaction and the need for personalized support in online settings.

In addition to the existing literature, several other scholars have made valuable contributions to the understanding of students' perceptions in online education. For instance, Chen and Jones (2021) examined the role of social presence and its impact on students' engagement and satisfaction in online learning environments. Their research highlighted the importance of fostering social connections and creating a sense of community to enhance students' experiences.

Furthermore, Brown et al. (2020) investigated the factors influencing student preferences for online versus face-to-face learning. Their study found that students' perceptions were influenced by factors such as convenience, flexibility, learning outcomes, and the availability of technological support.

Studies by Smith et al. (2021) and Johnson and Brown (2020) have explored factors influencing student satisfaction and engagement in online learning environments. These studies emphasize the importance of instructor presence, course design, and interactive features in shaping positive student perceptions.

Thompson and Williams (2019) focused specifically on students in technical disciplines, highlighting challenges such as the limitations of online platforms in providing hands-on experiences. Li et al. (2022) examined the effects of the pandemic on students' perceptions, revealing a range of responses including appreciation for flexibility and concerns about reduced social interaction.

Researchers like Chen and Jones (2021) have investigated the role of social presence and its impact on student engagement and satisfaction in online learning environments. Brown et al. (2020) explored factors influencing student preferences for online versus face-to-face learning, considering convenience, flexibility, and learning outcomes.

Results

Out of the 49 questions included in our survey, we have identified 9 key questions (Table 1) that exhibit a robustness score of 94.57%. These questions play a crucial role in helping us understand the factors that contribute to students' affinity towards online education. By analyzing the responses to these specific questions, we can create a detailed portrait of students who are more inclined towards online education. These important questions cover various aspects such as preferred learning environment, satisfaction with digital tools, accessibility of online resources, and the impact of social interaction in the online learning setting. By examining the responses to these questions, we can gain valuable insights into the characteristics and preferences of students who prefer online education over face-to-face education.

Table 1 – The most important questions based on Tree classifier

№	Question	Goal	Level of Gini coefficient
1	What is your subject area/ field of study?	This question helps identify if students from specific academic disciplines show a preference for online education. By analyzing the responses, we can determine if certain fields of study are more inclined towards online learning, providing insights into targeted approaches for online education in different disciplines.	0.444
2	To what level are you satisfied with your learning outcomes in the online learning environment?	This question assesses students' satisfaction with their learning outcomes in the online learning environment. Understanding the satisfaction levels helps gauge the effectiveness of online education in meeting students' learning needs and provides insights for improving instructional methods and course design.	0.566

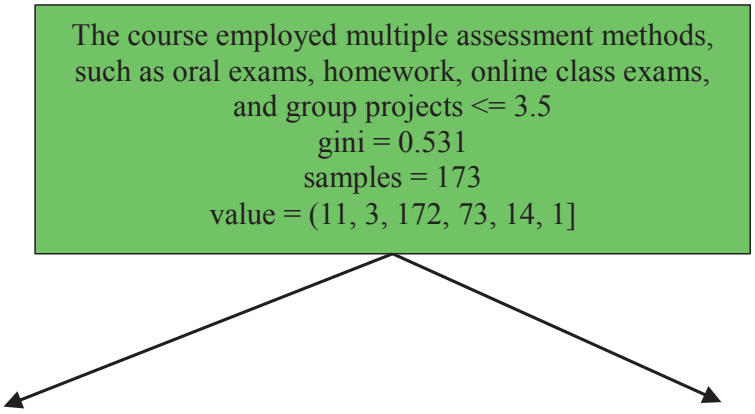
Continuation of Table 1

3	I am able to use synchronous technologies (Skype, Zoom, MS Teams) and asynchronous technologies (discussion boards, email) to communicate and engage with others in online courses.	This question measures students' comfort and proficiency in utilizing synchronous and asynchronous technologies for communication and engagement in online courses. It indicates the importance of effective communication tools in facilitating interaction and collaboration among students in the online learning environment.	0.377
4	In the future, I would like to improve my technology skills prior to registering for online classes.	This question explores students' willingness to enhance their technology skills before enrolling in online courses. It highlights the potential need for additional training or resources to support students in developing the necessary digital literacy skills required for successful online learning.	0.055
5	I would prefer NOT to take an online course that includes both male and female students in the future.	This question examines any potential gender-related preferences among students when it comes to the composition of online courses. It sheds light on the importance of considering gender dynamics and the creation of inclusive learning environments in online education.	0.124
6	In my experience, the internet connectivity is stable and sufficient for attending online classes, communicating with instructors and students, and performing tasks related to the course material.	This question assesses students' perception of internet connectivity and its impact on their online learning experience. It highlights the significance of reliable internet access in supporting effective participation and engagement in online courses.	0.32
7	As a student, I faced difficulties obtaining my own laptop or device to attend online classes, communicate with instructors and students, and perform tasks related to the course material.	This question explores any challenges students may face regarding access to personal devices for online learning. It draws attention to potential barriers that students may encounter and emphasizes the importance of ensuring equal access to necessary technology resources for all learners.	0.5
8	The course employed multiple assessment methods, such as oral exams, homework, online class exams, and group projects.	This question investigates the variety of assessment methods utilized in the online course. It signifies the importance of employing diverse assessment strategies to evaluate students' understanding and progress in online learning, providing a comprehensive evaluation of their knowledge and skills.	0.531
9	Overall, the course design considered the absence of physical interaction to promote instructor and student engagement and interaction by adopting different course content delivery methods.	This question assesses students' perception of course design and its ability to compensate for the lack of physical interaction in online education. It underscores the significance of innovative instructional approaches and engaging content delivery methods that facilitate interaction and collaboration among instructors and students.	0.407
Note: Compiled by the authors based on the survey data.			

Based on the data collected from these questions, we can develop well-informed recommendations and strategies to enhance the online learning experience for students. These recommendations can be tailored to address the specific needs and preferences of the identified student group. By understanding the factors that influence students' positive perception of online education, educational institutions can make targeted improvements and provide a more engaging and effective learning environment.

The robustness of these 9 questions reinforces their significance in capturing the nuances of students' preferences. By utilizing this valuable information, we can gain a deeper understanding of the student population and make data-driven recommendations to foster a successful online education environment for all learners n this study, we aimed to investigate the factors influencing students' preference for online education over traditional face-to-face learning. One of the key findings was that the course's utilization of multiple assessment methods, such as oral exams, homework, online class exams, and group projects, emerged as a significant factor (Gini coefficient = 0.531, sample size = 173). This factor played a crucial role in determining students' preference for online or offline education, with the survey respondents divided into two branches of 108 and 65 answers, respectively. Furthermore, the responses to the question "In the future, I would like to improve my technology skills prior to registering for online classes" (Gini coefficient = 0.055) were found to be dependent on the students' perspectives regarding stable internet connectivity for studying and attending online classes. This finding underscored the interdependence of these two factors in shaping students' preference for online education. Based on our analysis, we identified two distinct student profiles who exhibited a preference for online education based on their experiences. The first profile consisted of students who favored a combination of examination formats (oral and online) and demonstrated preparedness for online study courses, without experiencing any challenges with internet connectivity. This group constituted a significant proportion of students who showed a preference for online education over face-to-face learning. The second profile comprised students who had experienced courses with various assessment methods, including oral exams, and lacked physical interaction with peers and staff members (Gini coefficient = 0.407). These students expressed satisfaction with the learning outcomes of the online learning environment (Gini coefficient = 0.566) and displayed familiarity with online tools such as Zoom and Teams for communication and engagement during lessons (Gini coefficient = 0.377). Notably, this group also indicated a preference for single-gender classes (Gini coefficient = 0.124). Overall, the application of the Tree classifier and the analysis of responses to the 49 survey questions enabled us to identify the significant factors contributing to students' preference for online education over traditional face-to-face learning.

The results of analysis regarding predicting students preference for online education is shown at the figure 1. By analyzing the responses to these 9 questions, we can develop a comprehensive portrait of students who are more inclined towards online education. The insights gained can help inform recommendations and strategies to improve online learning experiences and meet the preferences and needs of students in various domains.



Continuation of Figure 1

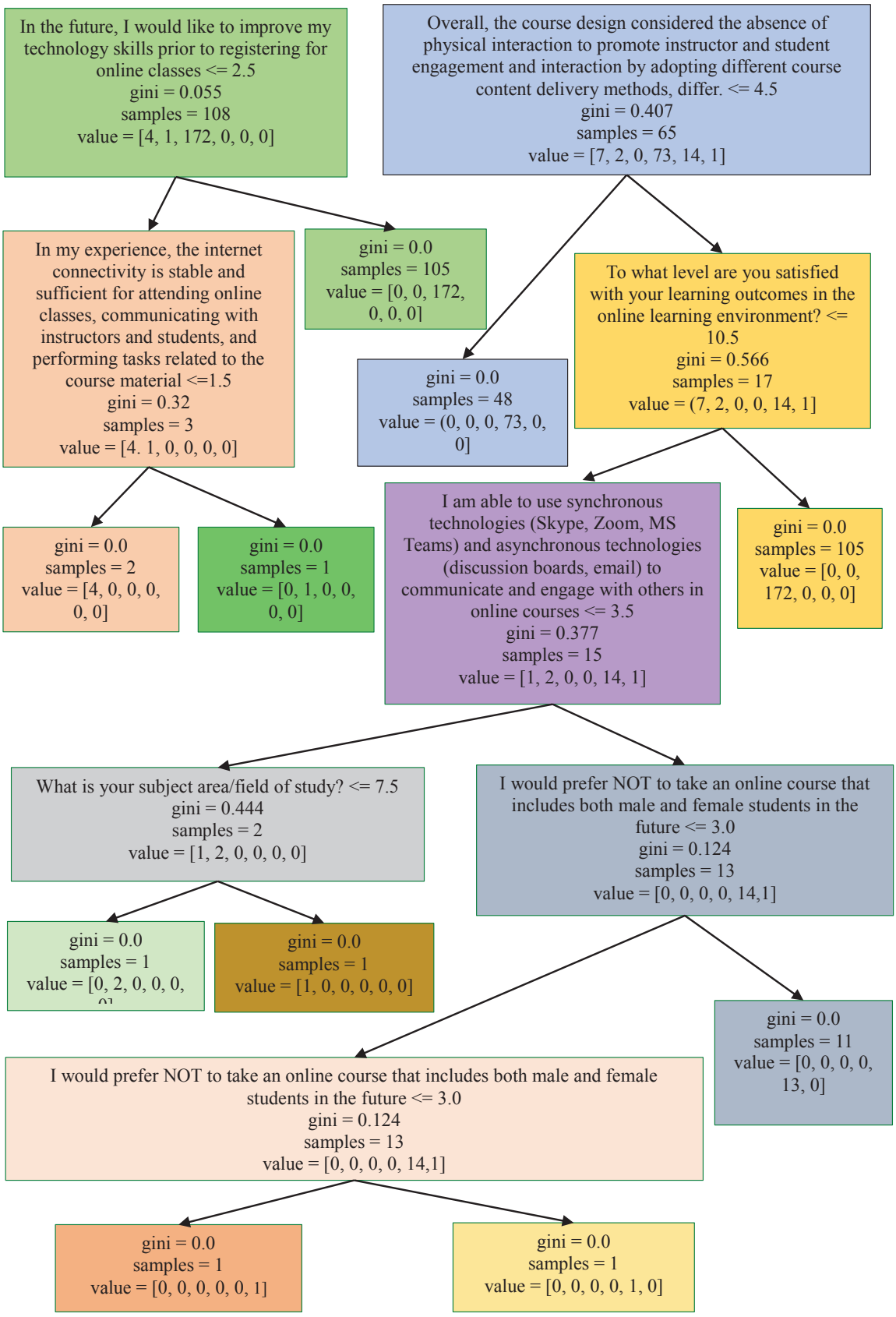


Figure 1 – Tree Classifier Results: Predicting Students Preference for Online Education

Note: Compiled by the authors based on the results obtained from the Tree Classifier analysis of the survey data.

Discussion

Before conducting the analysis using the Tree Classifier method, it is important to analyze our respondents based on key criteria such as gender, age, field of study, and current level of education. This preliminary analysis allows us to gain insights into the demographic and educational backgrounds of the survey participants, providing a contextual understanding of the data. By considering these factors, we can identify potential patterns and correlations that may influence preferences or outcomes related to online education. This comprehensive analysis of respondent characteristics forms a solid foundation for the subsequent application of the Tree Classifier algorithm, enabling us to make informed predictions and draw meaningful conclusions from the data.

Based on the questionnaire results shown in Figure 1, it is evident that there are different gender affiliations among the respondents. The data reveals that there are 24 males, 23 females, 222 individuals who choose not to disclose their gender affiliation, 93 who identify as non-binary, and 2 who identify as "other."

Figure 2 – Distribution of Respondents by Gender

Note: Compiled by the authors based on the primary sources.

These statistics highlight the diversity of gender identities and the importance of creating inclusive environments that respect and recognize individuals beyond traditional binary categorizations

Based on the data provided in Figure 2, it seems that the majority of the respondents who participated in the survey fall within the age range of 25–34, with a total of 222 respondents. The remaining respondents are distributed as follows: under 18–25 respondents, 18–24–40 respondents, 35–44–94 respondents, and 55 and over – 2 respondents.

Figure 3 – Age Distribution of Survey respondents

Note: Compiled by the authors based on the primary sources.

This distribution of age groups in your survey can provide valuable insights into the preferences and behaviors of different demographics when it comes to online education. Understanding the age range of your respondents can help you tailor your educational offerings to better meet their needs.

The fact that the majority of the respondents fell into the 25–34 age range suggests that this group is particularly interested in online education. This age group often consists of young professionals who may be looking to enhance their skills or further their education while balancing work and other responsibilities. They might be attracted to the flexibility and convenience that online education offers.

It is worth noting that there were also participants in other age groups, including younger individuals under 18 and students in the 18–24 age range. This indicates that online education is not limited to a specific age group and can cater to a wide range of learners. It also highlights the importance of providing age-appropriate content and learning experiences to engage and support these different demographics effectively.

Additionally, the presence of respondents in the 35–44 and 55 and over age groups suggests that there is interest in online education among mid-career professionals and older adults. These individuals may be seeking to update their skills or pursue new career opportunities. Understanding their specific needs and preferences can help you design relevant and engaging online courses.

According to the survey on the question "What is your current level of education?", we can see that the respondents who participated in the survey had the following levels of education: Progressive – 222, Graduate – 95, Post-Graduate Student – 5, Undergraduate Student – 42, the level of education is not sufficient – 1, Low – 1. Figure 3.

These results provide insights into the educational background of the participants in the online education survey. The majority of respondents, 222 individuals, have a progressive level of education. This might indicate that they have already completed some form of higher education and are now pursuing further learning opportunities online.

Additionally, 95 respondents reported having a graduate level of education. This suggests that they have completed a bachelor's degree and are now pursuing a higher level of education, such as a master's or doctoral degree, through online platforms.

There were also a few respondents who identified as Post-Graduate Students (5 individuals) and Undergraduate Students (42 individuals). These individuals are likely currently enrolled in post-graduate or undergraduate programs respectively, and are using online education to supplement their studies or gain additional knowledge.

Interestingly, there were a few respondents who indicated that their level of education is not sufficient (1 individual) or low (1 individual). This might suggest that they are seeking online education as a means to improve their educational qualifications or enhance their knowledge in a specific area.

The data demonstrates that individuals from various educational levels are utilizing online platforms to further their education, whether it be to advance their careers, gain new skills, or fulfill personal interests.

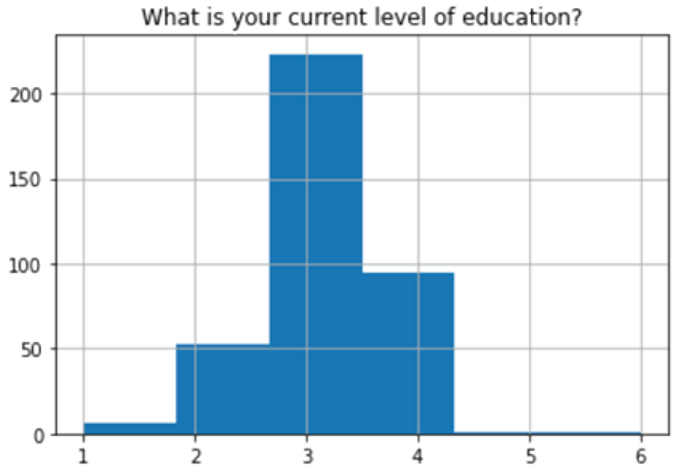


Figure 4 – Distribution of Respondents by Current Level of Education

Note: Compiled by the authors based on the primary sources.

The participants were from various fields, including art and design, architecture, biological sciences, other subjects allied to health, engineering, English, law, modern languages, food and agricultural sciences, geology, environmental sciences, archaeology, ancient history, maths, physics, chemistry, informatics, computing, medical sciences, dental sciences, veterinary science, social sciences, history, economics, business, management, and others. Figure 4.

From the results, it can be observed that Engineering had the highest number of respondents with 224 participants. This indicates a significant interest in online education within the field of Engineering. Following Engineering, English, law, and modern languages had 97 respondents, suggesting a considerable interest in these subjects as well.

On the other hand, some subject areas had a relatively lower number of respondents. For example, art and design and architecture had only 1 respondent, indicating a lesser interest in online education within this domain. Similarly, Social sciences, history, economics, business, and management had only 1 respondent, suggesting a lower level of interest in online education within these disciplines.

It is worth noting that Biological sciences and other subjects allied to health had 6 respondents, indicating a moderate level of interest in online education within this field. The same can be said for Food and agricultural sciences, Geology, environmental sciences, archaeology, and ancient history, Maths, physics, chemistry, informatics, and computing, and Medical, dental, and veterinary science, as they had 11, 4, 14, and 7 respondents respectively.

Overall, these results provide insights into the subject areas or fields of study that respondents have an interest in pursuing through online education. It is evident that there is a diverse range of interests among the respondents, with some fields attracting more participants than others.

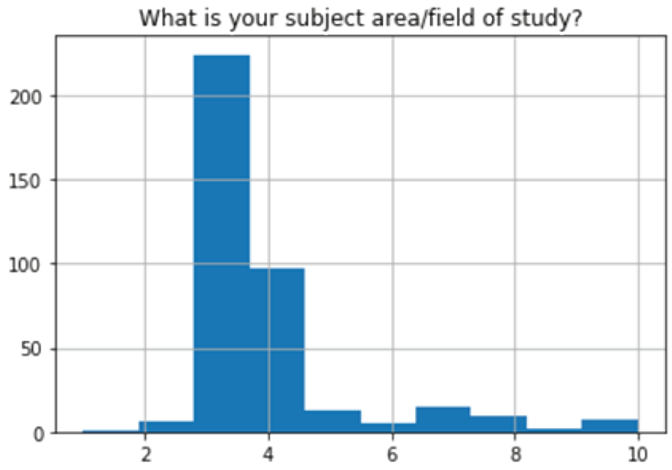


Figure 5 – Distribution of Respondents by Field of Study

Note: Compiled by the authors based on the primary sources.

Conclusion

Based on our analysis using the Tree Classifier method, a detailed portrait of students who prefer online education over face-to-face learning can be constructed. These students exhibit several common characteristics and preferences that shape their inclination towards online education.

Firstly, these students express a high level of satisfaction with their learning outcomes in the online learning environment. They find that online education effectively meets their educational needs and enables them to achieve their desired learning goals. This satisfaction indicates their positive perception of the quality and effectiveness of online education.

Additionally, students who prefer online education demonstrate proficiency in utilizing various synchronous and asynchronous technologies for communication and engagement. They are comfortable using tools such as Skype, Zoom, MS Teams, discussion boards, and email to collaborate with their peers and engage in course-related activities. This proficiency in technology facilitates their active participation and interaction in the online learning environment.

Furthermore, these students show a willingness to improve their technology skills prior to enrolling in online classes. They recognize the importance of being technologically competent and seek opportunities to enhance their digital literacy. This proactive approach highlights their commitment to maximizing their online learning experience by developing the necessary skills to navigate digital platforms effectively.

Stable and sufficient internet connectivity is a crucial factor for these students. They perceive reliable internet access as essential for attending online classes, communicating with instructors and fellow students, and completing course-related tasks. A stable internet connection ensures seamless participation in online activities, facilitating uninterrupted learning experiences.

The preference for online education among these students is not influenced by gender composition in their courses. They do not express a specific preference for single-gender or mixed-gender online courses, emphasizing the importance of inclusivity and diverse learning environments in their educational journey.

Moreover, access to personal devices can impact their preference for online education. Some students may face challenges in obtaining their own laptops or devices for attending online classes and engaging with course materials. Addressing these accessibility concerns can contribute to a more equitable online learning experience for all students.

The course design plays a significant role in shaping their preference for online education. These students appreciate course designs that consider the absence of physical interaction and adopt alternative methods to promote instructor-student engagement and interaction. By employing various content delivery methods and assessment strategies, the course design ensures an engaging and interactive learning experience despite the lack of in-person interaction.

Overall, the portrait of students who prefer online education reveals individuals who are satisfied with their learning outcomes, proficient in utilizing technology for communication, open to enhancing their technology skills, reliant on stable internet connectivity, comfortable with mixed-gender courses, and appreciative of course designs that foster engagement. Understanding these characteristics and preferences is crucial for institutions to tailor their online education offerings, support services, and technological infrastructure to meet the specific needs of these students and provide an optimal online learning experience. To optimize the online education experience, several recommendations can be derived from the analysis and results. First, it is advisable to offer preparatory technology skill development programs to equip students with essential competencies before they embark on online education. These programs should focus on familiarizing students with common online learning tools and platforms. Additionally, implementing digital literacy training initiatives will ensure students are well-prepared to navigate the online learning environment effectively. Educational institutions should provide accessibility support and device assistance to ensure all students have access to required technology and reliable internet connectivity. Furthermore, fostering inclusive course design, establishing robust student support services, encouraging collaborative learning opportunities, implementing continuous assessment and feedback mechanisms, providing professional development for instructors, and emphasizing evaluation and continuous improvement will contribute to the overall success and quality of online education programs.

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АҒАШ КЛАССИФИКАТОРЫН ТАЛДАУ АРҚЫЛЫ ОНЛАЙН БІЛІМ БЕРУДЕ ОҚУШЫЛАРДЫҢ ҚАБЫЛДАУЫН АШУ

Аңдатпа

Бұл мақалада Tree Classifier алгоритмін қолдана отырып, студенттердің онлайн білім беруді қабылдауын талдау ұсынылған. Зерттеуге Covid-19 пандемиясы кезінде онлайн оқытуға қатысқан 460 студенттің сауалнамасы кіреді. 49 сұрақтан тұратын сауалнама студенттердің тәжірибесін, қиындықтарын, алынған қолдауды және онлайн білім беруге қатысты қалауларын түсінуге бағытталған. Негізгі мақсат – бетпе-бет оқудан гөрі онлайн оқуды қалайтын студенттер тобын анықтау. Осы зерттеу аясында Python-да Tree Classifier алгоритмін қолдана отырып, студенттердің онлайн білім беруді қабылдауының құнды идеялары алынады. Алматы қаласының (Қазақстан) студенттеріне назар аудара отырып, зерттеу онлайн, бетпе-бет немесе аралас оқыту форматтарын жақсарту бойынша болашақ зерттеулер мен ұсыныстарды анықтау үшін ұқсас халықаралық зерттеулермен әлеуетті салыстыруға мүмкіндік береді. Нәтижелер студенттердің қанағаттануына, сабаққа қатысуына және онлайн оқуды қалайтынына әсер ететін факторларды анықтайды. Осы түсініктерге сүйене отырып, зерттеу онлайн оқыту тәжірибесін жақсарту және анықталған қиындықтарды шешу үшін практикалық ұсыныстар береді. Алматы қаласы студенттерінің тәжірибесі негізінде онлайн-білім беруде студенттердің қабылдауы мен қалауын жан-жақты түсіну ұсынылады. Алынған нәтижелер, сондай-ақ басқа елдердің тәжірибесін салыстырмалы талдау, біздің ойымызша, болашақ зерттеулер үшін құнды ақпарат болады, онлайн оқыту сапасын жақсартуға ықпал етеді, сонымен қатар тәрбиешілер, саясаткерлер мен зерттеушілер үшін құнды ресурс болады.

Тірек сөздер: онлайн білім беру, артықшылықтар, ағаш классификаторы, сауалнама, халықаралық зерттеулер, ұсыныстар, студенттердің қанағаттануы.

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РАСКРЫТИЕ ВОСПРИЯТИЯ СТУДЕНТОВ В ОНЛАЙН-ОБРАЗОВАНИИ ЧЕРЕЗ АНАЛИЗ КЛАССИФИКАТОРА ДЕРЕВЬЕВ

Аннотация

В данной статье представлен анализ восприятия студентами онлайн-образования с использованием алгоритма Tree Classifier. Исследование включает опрос 460 студентов, которые принимали участие в онлайн-обучении во время пандемии Covid-19. С помощью 49 вопросов опрос направлен на понимание опыта студентов, столкновений, полученной поддержки и предпочтений в отношении онлайн-образования. Основная цель – выявить группу студентов, предпочитающих онлайн-обучение лицом к лицу. В рамках данного исследования с использованием алгоритма Tree Classifier на Python извлекаются ценные идеи восприятия студентами онлайн-образования. Сфокусировавшись на студентах г. Алматы (Казахстан), авторы имели возможность провести сравнение с подобными международными исследованиями, чтобы создать основу для дальнейших исследований и рекомендаций по улучшению онлайн-, очного или смешанного форматов обучения. Полученные результаты проливают свет на факторы, влияющие на удовлетворенность студентов, их вовлеченность и предпочтения в онлайн-обучении. Основываясь на полученных выводах, авторы предлагают практические рекомендации для улучшения опыта онлайн-обучения и решения выявленных проблем. Предлагается всестороннее понимание восприятия и предпочтений студентов в онлайн-образовании на основе опыта студентов г. Алматы. Полученные результаты, а также сравнительный анализ опыта других стран, послужат, на наш взгляд, ценной информацией для будущих исследований, будут способствовать улучшению качества онлайн-обучения, а также будут ценным ресурсом для педагогов, политиков и исследователей.

Ключевые слова: онлайн-образование, предпочтения, классификатор деревьев, опрос, международные исследования, рекомендации, удовлетворенность студентов.