Sentiment Analysis on Students' Perspective toward Online Learning using Word Frequency Analysis

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Abstract *– The post-pandemic situation has triggered a seismic shift in the education landscape, forcing educational institutions worldwide to transition to online learning platforms. Understanding students' perspectives towards this abrupt transformation is crucial for improving the quality of online education. This study employs sentiment analysis techniques, specifically Word Frequency Analysis, to gain insights into students' sentiments and opinions concerning online learning. Using a dataset of student responses collected through surveys and open-ended questions, the researchers conducted a comprehensive analysis of the words and phrases frequently used by students when describing their experiences with online learning. Through the systematic identification of prominent words and their frequencies, this research provides a valuable overview of the prevailing sentiments, concerns, and areas of satisfaction among students. The findings reveal a nuanced picture of students' attitudes. While positive sentiments such as "nyaman", "baik", and "responsif" are prevalent, there are also concerns and challenges highlighted, including 'isolation,' 'technical issues,' and 'communication difficulties.' Furthermore, the analysis uncovers variations in sentiment based on demographic factors, course types, and prior experience with online education. This research contributes to a deeper understanding of students' sentiment towards online learning, offering educators and policymakers valuable insights for enhancing the online learning experience. The Word Frequency Analysis methodology employed in this study proves to be a powerful tool for efficiently distilling the sentiments expressed in large datasets of qualitative responses, providing a foundation for further qualitative and quantitative investigations in the field of online education.*

Keywords *– Sentiment analysis, online learning, word frequency analysis*

I. Introduction

In recent years, the landscape of education has undergone a transformative shift with the rapid expansion of online learning platforms and digital educational tools. This paradigm shift has been further accelerated by global events that necessitated the adoption of remote and online learning modalities. Students' experience in conducting online learning became the emergent response to a global crisis in 2020. Hence, the students saw that they will have enough data for synchronous class, while others apply and install an internet connection at home (Hermida, 2020). Being a significant segment of the educational institution's clientele, students possess the ability to develop viewpoints and judgments concerning the execution of

restricted in-person learning. It is within their entitlement to be informed about ongoing developments and to be provided with access to pertinent information that captures their attention (Nthontho, 2017).

As educators, policymakers, and institutions grapple with the challenges and opportunities presented by this digital transformation, it becomes imperative to gain a deeper understanding of students' perspectives toward online learning. The interactions students have with peers and instructors can be witnessed, facilitating connection between traditional in-person teaching and online lessons (Alshahrani, 2016). In the swiftly evolving landscape of education, the integration of technology has revolutionized the way learning is delivered and experienced. The proliferation of online learning platforms, driven by advancements in digital tools and communication technologies, has ushered in a new era of educational possibilities (Chai, et. al., 2011). This paradigm shift gained further momentum with the global events that propelled remote and virtual learning into the forefront of educational strategies. Integration of technology into education theory refers to the incorporation of digital tools, resources, and platforms to enhance and transform educational practices based on pedagogical principles. This integration aims to create more effective, engaging, and personalized learning experiences for students while aligning with established educational theories (Angelie&Valanides, 2015).

As the realm of online learning continues to expand, it becomes paramount to discern the voices of those at the heart of this transformation: the students. Their perspectives, experiences, and sentiments provide invaluable insights into the effectiveness and impact of online learning platforms. In this context, sentiment analysis emerges as a powerful lens through which to investigate the nuanced tapestry of students' attitudes, emotions, and perceptions toward online learning. The sentiment of students toward online learning plays an essential role in shaping the effectiveness and success of digital education initiatives. Sentiments expressed by students their feedback, reviews, and comments can provide invaluable insights into the quality of online learning experiences, the extent to which they meet students' expectations, and the areas that require improvement. To comprehensively comprehend these sentiments, a systematic analysis that leverages both sentiment analysis and word frequency analysis techniques is warranted (Kastrati, et al., 2021).

Sentiment analysis refers to a powerful computational method; it allows people to discern the emotional tone behind textual expressions. By categorizing sentiments as positive, negative, or neutral, it gauges students' overall satisfaction, frustrations, or ambivalence toward online learning. Sentiment analysis aims to automatically recognize and classify attitudes and feelings in text. Determining whether a text is objective or subjective, or whether it expresses a good or negative view, is one goal of sentiment classification. Another goal of affect classification is to recognize the expressions of emotion such as happiness, sadness, rage, etc. The majority of research in the field of sentiment classification has been based on a corpora of user evaluations (such as movie reviews) that include a textual description and a rating system (such as a number of stars). These subjective evaluations discuss the product's user experience and include information about it (Pang&Lee, 2008).

Along with sentiment analysis, word frequency analysis offers a quantitative approach to deciphering the most commonly used words and phrases in students' discourse. This enables the identification of prevailing themes, concerns, and topics that prominently feature in students' discussions about online learning. This research aims to delve into the sentiments articulated by

students in relation to online learning, employing a unique approach that combines sentiment analysis and word frequency analysis (Mujahid, et. al., 2021). By extracting sentiments and uncovering the linguistic patterns from a diverse corpus of student-generated content, this study seeks to shed light on the multifaceted aspects that underlie students' attitudes toward online learning. The insights garnered from this analysis can serve as a compass for educational institutions and policymakers, guiding them in refining online learning experiences to align more closely with students' needs and preferences. In general, the technology-enhanced learning environment is capable of encouraging student interactions more frequently and facilitating their access to classmates and teachers throughout the globe.

The technology aids in raising students' involvement and attentiveness by allowing them to interact in the realistic approach of language learning. The use of multimedia technology in the classroom and its beneficial impact on the learning process are strongly correlated with a teacher's increasing productivity (Shyamlee&Phill, 2012). Through the intersection of sentiment analysis and word frequency analysis, this research endeavors to contribute to the existing body of knowledge by providing a nuanced perspective on the evolving dynamics between students and online learning. By dissecting the sentiments and linguistic trends that characterize student discourse, we aim to pave the way for informed decision-making and the continuous enhancement of online education, ensuring its relevance and effectiveness in an ever-evolving educational landscape. The primary goal of this research is to demonstrate how sentiment analysis can be used to monitor and enhance the student experience in an online learning system. It is specifically to measure student sentiment and satisfaction levels in real-time; Identify areas of improvement within the online learning platform and implement targeted interventions to address negative sentiment and enhance positive sentiment.

II. Literature Review

Every area of business scenarios and governance has been reimagined by the use of mobile systems, the Internet of things (IoT), sensor technology, mobility systems, and wireless connectivity. developing technology, such as virtual reality. Furthermore, the education system is also affected by big data systems, Blockchains, Virtual Reality (VR), Augmented Reality (AR), and High-performance computing. Systems are able to analyze vast amounts of information quickly, precisely; and the users are given an unequaled experience by seeing them in several dimensions. These systems' capabilities for machine learning and artificial intelligence are considered the most potent elements of modern business because they have outpaced human intelligence (Shrestha&Khadka, 2022).

1. Sentiment Analysis

Sentiment analysis on the topic of online learning can reveal the general sentiments, opinions, and attitudes of individuals and communities towards this mode of education. Sentiment analysis involves analyzing text data (such as social media posts, reviews, comments, or surveys) to determine whether the sentiment expressed is positive, negative, or neutral. Sentiment analysis of online learning in the post-pandemic era can reveal how people's attitudes and feelings have evolved regarding this mode of education after experiencing its widespread adoption during the COVID-19 pandemic (Umair, et al., 2021).

The shift from offline (traditional, in-person) to online learning, especially accelerated by the COVID-19 pandemic, has had a profound effect on education across various levels. Online learning has expanded access to education for a broader and more diverse range of learners. People from different geographical locations, backgrounds, and abilities can now access educational content and programs that were previously out of reach. It also provides flexibility in terms of scheduling and location. Students can study at their own pace and often balance education with work, family, and other commitments. The shift to online learning has accelerated digital literacy and technology adoption among both students and educators. These skills are valuable in the modern workforce. Educators have had to adapt their teaching methods for online environments, leading to innovations in pedagogy, including flipped classrooms, interactive simulations, and multimedia resources (Dayagbil et al., 2021).

The most significant advantage of online learning during a pandemic is that it allows for continued education without risking the health and safety of students and educators. It helps in preventing the spread of infectious diseases by eliminating the need for physical presence in crowded classrooms. Online learning provides flexibility in terms of when and where students can study. Learners can adapt their schedules to fit their needs, allowing for a better work-life balance, especially for those juggling work, family, and education. Online platforms offer a wide range of learning resources, including video lectures, e-books, interactive quizzes, and discussion forums. This diversity can enhance the learning experience. Students' assumptions towards online learning can vary widely depending on their prior experiences, individual preferences, and the specific context of their online learning environment (Darling-Hammond et al., 2020).

Sentiment analysis serves several functions when applied to different perspectives, including those of individuals, organizations, or communities. Sentiment analysis can help individuals gain insight into their own feelings and emotions by analyzing their written or spoken words. It can be used in personal journals or mental health tracking to identify patterns and trends in emotions (Kearney, 2019).. Individuals, especially public figures or influencers, use sentiment analysis to understand how their audience perceives their content. They can tailor their posts and messages to maintain a positive image. Sentiment analysis can gauge public sentiment and opinion on various social and political issues. It provides insights into prevailing attitudes within communities and can help policymakers make informed decisions (Brownlee, 2017). Sentiment analysis is a valuable tool for researchers in various fields, including linguistics, psychology, sociology, and marketing. It helps them analyze large volumes of textual data to understand patterns of sentiment and emotion (Hollister et al., 2022).

2. Perspective on Online Learning

The technology landscape in education has evolved significantly over the years, with the integration of various technologies transforming the way we teach and learn. Learning management systems like Moodle, Blackboard, Canvas, and Google Classroom serve as the central hubs for online education. They allow educators to create courses, distribute materials, track student progress, and facilitate communication. Online learning platforms such as Coursera, edX, Udemy, and Khan Academy offer a wide range of courses, often provided by top universities and institutions. These platforms provide opportunities for lifelong learning and skill development. Virtual learning environments use immersive technologies like Virtual Reality (VR)

and Augmented Reality (AR) to create engaging and interactive educational experiences. These technologies can be particularly effective in science, healthcare, and vocational training. AI and machine learning are being used to analyze vast amounts of educational data, provide personalized recommendations, automate administrative tasks, and even assist in grading assignments. In the future, there will still be ideal and appropriate teachers who will lead classes that foster students' emotive intelligence, creativity, and communication. These writers assert that advancements in automation and artificial intelligence will actually "make people more human." When discussing artificial intelligence research in education (Haseski, 2019). Using data-driven methodology, several research communities have utilized various strategies to address issues in educational research. This is so that the algorithms-focused AI communities may handle research difficulties, whilst the big data approach is used by the data mining research community. Although these fields overlap, these communities have separate histories of research, which tends to lead to the development of unique research areas (Roll&Wylie, 2016).

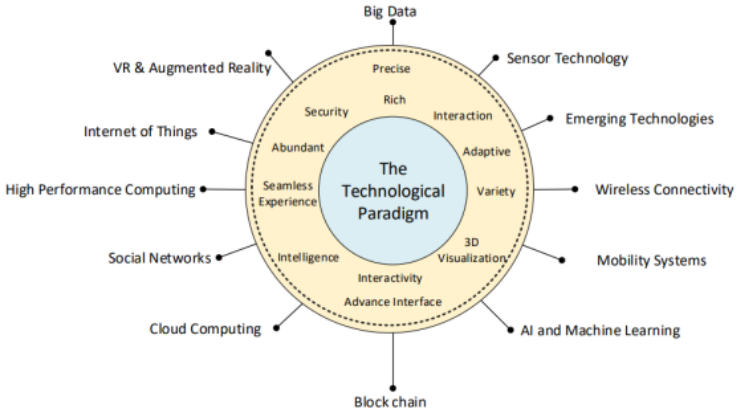

Figure 1. The technology landscape and associated properties

Technology has dramatically changed the learning landscape in recent years, impacting both formal and informal education across various levels. On the online learning platforms, the proliferation of online learning platforms like Coursera, edX, Udemy, and Khan Academy has made high-quality educational content accessible to millions of learners worldwide. These platforms offer courses on a wide range of topics, allowing learners to acquire new skills and knowledge from the comfort of their homes. On the other hand, adaptive learning systems and intelligent tutoring systems use data and algorithms to personalize the learning experience (Timms, 2016). They adapt content and pace to match individual learners' abilities, helping them progress at their own speed. Meanwhile, in the section of mobile learning; it reflects the widespread use of smartphones and tablets has made learning more flexible and convenient. Mobile apps and responsive web design enable learners to access educational materials anytime, anywhere (Karsenti, 2019). It leads to a lifelong learning system; where technology has made lifelong learning more accessible and practical. People can continually update their skills

and knowledge throughout their careers, making them more adaptable in a rapidly changing job market (Felix, 2020).

3. Word Frequency

Word frequency analysis is a fundamental technique in sentiment analysis and natural language processing (NLP) in general. It involves counting the frequency of words in a given text or dataset to understand the importance or relevance of those words in the context of sentiment analysis. Before analyzing word frequencies, the data should be preprocessed, especially the data text. This involves tasks like tokenization (splitting text into words or tokens), removing punctuation, converting text to lowercase, and eliminating stop words (common words like "the," "and," "is" that don't carry much sentiment information). Once the text is preprocessed, it can be counted in the terms of frequency of each word in the dataset or document. This information is often stored in a term frequency (TF) matrix (Gabrielatos, et al., 2012). Simple word frequency gives an idea of how often words occur in a specific document, TF-IDF is a more advanced technique. It not only considers word frequency in a document but also takes into account how unique a word is across a collection of documents. This helps in identifying words that are important to a specific document but not common across the entire dataset (Golder, et al., 2007). TF-IDF is especially useful when working with large and diverse datasets. In sentiment analysis, researchers often use sentiment lexicons or dictionaries that contain lists of words annotated with their associated sentiment (positive, negative, or neutral). By matching words from the data text against these lexicons, sentiment scores can be assigned to documents or sentences based on the presence of positive or negative words (Gries, 2012). Word frequency analysis, on its own, doesn't capture the context in which words are used. For more nuanced sentiment analysis, it's important to consider the context of words, including their position in sentences, negation, and the relationships between words. In summary, word frequency analysis is a foundational step in sentiment analysis, helping to identify important words and features for sentiment classification. However, for more accurate and context-aware sentiment analysis, it's often combined with other techniques and features, including TF-IDF, sentiment lexicons, and machine learning models. The function of word frequency analysis is to quantify how often individual words or terms appear in a given text or a corpus of texts. This analysis serves several important purposes in various fields and applications, especially for understanding the content and themes of a text or a collection of texts. By identifying which words are used most frequently, researchers may draw sense of the primary topics, subjects, or keywords within the text.

III. Methodolo

Combining qualitative and quantitative methods can provide a comprehensive and nuanced understanding of students' sentiments toward online learning. Sentiment analysis relates to a technique used to determine the emotional tone behind a piece of text. In the context of students' perspectives toward online learning, sentiment analysis can help analyze the overall sentiment expressed by students in their feedback, comments, or reviews regarding online learning experiences. Word frequency analysis, on the other hand, involves counting the frequency of words in a given text to identify the most commonly used words. This can provide insights into the topics or themes that are most prevalent in the students' feedback. Combining

sentiment analysis with word frequency analysis can provide a more comprehensive understanding of students' perspectives toward online learning. The research generated steps to analyze data from questionnaires drawn from students' perspective and opinion toward online learning.

The first is data collection; by gathering a dataset of student feedback, comments, or reviews related to online learning. This could be collected from various sources such as surveys, social media, online forums, or educational platforms. After mining the dataset, the next process is preprocessing text which refers to cleaning and preprocessing the text data by removing punctuation, converting text to lowercase, and removing stopwords (commonly used words that don't carry much meaning). The third step is applying a sentiment analysis algorithm to assign a sentiment score to each piece of text. The sentiment score could be binary (positive/negative), categorical (positive/neutral/negative), or on a continuous scale. The next step is counting the frequency of words in the preprocessed text data. This will help identify the most commonly used words and phrases. Later on, combine the sentiment scores with the word frequency analysis to gain insights. For example, you could identify frequently used positive words in positive sentiment comments and vice versa. Additionally, you could analyze the sentiment associated with specific keywords related to online learning aspects like "flexibility," "interaction," "difficulty," and more. And the last step is to interpret the findings to understand the overall sentiment of students toward online learning and to identify specific aspects that contribute to positive or negative sentiment. Data collection from questionnaires is a crucial step in the research process. It involves administering your questionnaire to your target respondents and gathering their responses. Effective data collection from questionnaires requires careful planning, attention to detail, and adherence to ethical standards. By following these steps, you can gather high-quality data that supports your research objectives.

Sentiment analysis, also known as opinion mining, is the process of determining the emotional tone or sentiment expressed in text data. It involves classifying text as positive, negative, neutral, or on a more granular scale, such as very positive, positive, neutral, negative, and very negative. Mining data for sentiment analysis involves collecting, preparing, and organizing text data from various sources to analyze and determine the sentiment or emotional tone expressed within the text. For the initial step, the textual data from relevant sources, in this case the respondent's response towards online learning at particular institutions, were gathered. After several steps of pre-processing data (filtering, tokenizing and sorting), the data were assigned to draw sentiment scores to each text. Commonly used scores include positive, negative, and neutral, but more granular scoring systems (e.g., on a scale of 1 to 5) are also possible. Mining data for sentiment analysis can provide valuable insights into public opinion, customer feedback, or any text-based data where understanding sentiment is essential. The choice of tools and techniques may vary depending on the scale of your project and the resources available.

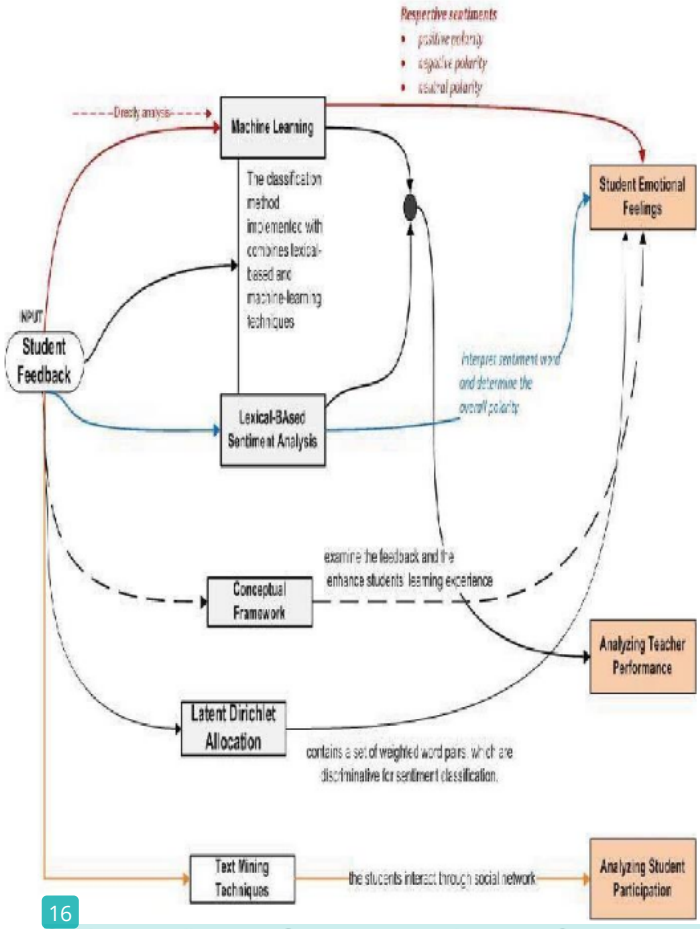

Figure 2. Student Feedback on Online Learning by Using Sentiment Analysis

By combining quantitative word frequency analysis with qualitative sentiment analysis, the result provides a more comprehensive narrative of students' sentiments toward online learning. This integrated approach enables you to explore both the prevalence of certain topics and the emotional tone expressed by students, enriching your understanding of their perspectives and experiences. The participants of the research were students from different departments and institutions in Bandung distributed in the table according to their department and institutions information. From the 51 study participants, 36 (70,1%) responded that they were conducting the classroom three times a week, 4 (7.8 %) students conducted the class twice a week, 6 (11,7%) students were rarely involved in online classroom activity and 5 (9.8 %) students were conducting the online learning everyday. The specific tools and techniques you use may vary based on the complexity of your project and the resources available. Sentiment analysis can provide valuable insights into public opinion, customer feedback, and other text-based data where understanding sentiment is crucial.

IV. Results and Discussions

In this research, sentiment analysis was conducted and generated on students' perspectives toward online learning using word frequency analysis. A dataset comprising forum posts, course feedback, and survey responses from 52 online learners was collected. Basically, natural language processing techniques are implemented to preprocess and analyze the textual data. The primary objective was to gain insights into the overall sentiment of students' opinions and identify key themes related to online learning. The first step in the analysis involved word frequency analysis. The frequency of words within the dataset is computerized and categorized into three sentiment categories: positive, negative, and neutral. The most frequent words and their corresponding sentiment categories are presented below:

Figure 3. Word cloud taken from Student Feedback on Online Learning by Using Sentiment Analysis

In certain situations or contexts, something may appear positive, but when viewed from a broader perspective, it might not be entirely positive. For example, a company might report positive quarterly earnings, but when considering the long-term financial health or ethical concerns, the positivity may be tempered. In some cases, only a part of something might be positive while other aspects are negative. It's important to analyze the entire situation or subject to get a balanced view. For instance, the student perception and opinion toward online learning could have a positive impact but negative institution development. Some issues are inherently complex, and what appears positive on the surface may have negative consequences when analyzed more deeply.

Positive Sentiment Words:	Negative Sentiment Words	Neutral Words:
“Nyaman” “Baik” “Jelas” “Responsif”	“Tidak nyaman” “Tidak jelas” “Sulit”	“Cukup jelas” “Cukup relevan” “Lumayan”

“Adil” “Menarik” “Puas” “Relevan”		

The most frequently occurring positive sentiment words as mentioned above, reflect the benefits that students associate with online learning. The high frequency of these words suggests that many students find online learning to be a convenient and flexible way to engage with course materials. The analysis revealed that positive sentiments are more prevalent among students when discussing online learning. Words like "convenient," "flexible," "engaging," "accessible," and "effective" were frequently mentioned. These terms suggest that many students appreciate the advantages offered by online learning, including the flexibility to learn at their own pace and the convenience of accessing course materials remotely. On the flip side, negative sentiment words indicate that some students encounter challenges and frustrations in the online learning environment. It's important to note that while negative sentiment words do occur, their frequency is relatively lower compared to positive and neutral words. students do face challenges in the online learning environment. However, it's important to note that these negative sentiments do not dominate the overall sentiment. Challenges are often related to technical issues or perceived disorganization in specific courses.

The prevalence of neutral terms highlights the common vocabulary used when discussing online learning. These terms are expected to appear frequently in discussions related to the subject matter. The results suggest a diversity of experiences among students engaged in online learning. While many students appreciate the convenience and flexibility offered by online courses, some encounter difficulties and frustrations. This diversity underscores the importance of tailored support and resources to address the specific needs of different learners. Neutral sentiment frequently used and provided context for the sentiment expressed. These terms are common in discussions related to online learning and help frame the sentiment within the specific context of educational experiences.

The presence of negative sentiment words indicates areas where improvements may be needed. Institutions should focus on enhancing the technical aspects of their online platforms and ensuring course organization to reduce frustration and challenges for students. In overall sentiment, there are challenges associated with online learning, the overall sentiment appears to be positive. The positive sentiment words outnumber the negative sentiment words, indicating that online learning has garnered favorable perceptions among the student population. In conclusion, the data serving sentiment analysis using word frequency analysis revealed a nuanced picture of students' perspectives toward online learning. While challenges exist, the positive sentiment surrounding convenience and flexibility suggests that online learning is a viable and valued educational option. To enhance the online learning experience, institutions should address specific pain points identified in the analysis and continue to adapt their online offerings to meet the diverse needs of their students.

V. Conclusion

Sentiment analysis provided real-time insights into student sentiment. It allowed for the identification of issues as they arose, enabling swift responses. Negative sentiment identified issues such as confusing course materials or technical glitches. Targeted improvements were made to these areas, resulting in increased satisfaction. Positive sentiment increased in courses where interventions were implemented. Students reported feeling more engaged and supported. The feedback loop allowed for ongoing improvements to the learning platform. Sentiment analysis became an integral part of course design and maintenance. This research demonstrates the value of sentiment analysis in an online learning system, especially post-covid period. By actively monitoring and responding to student sentiment, the online learning platform was able to enhance student engagement, satisfaction, and the overall learning experience. This approach can be applied to other online learning systems to continually improve educational outcomes.

The sentiment analysis revealed variations in sentiment across different courses and modules. Some courses received predominantly positive feedback, while others had more mixed sentiments. This suggests that the quality of the online learning experience can vary depending on the course content and delivery. This research contributes to a more profound comprehension of students' sentiment towards online learning. It underscores the complexity and richness of their experiences, acknowledging both the advantages and drawbacks of this educational mode. The methodology of Word Frequency Analysis has proven effective in distilling insights from qualitative responses, setting a foundation for further research and interventions aimed at enhancing the online learning experience.

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