

Article

Investigating Factors Influencing Students' Engagement in Sustainable Online Education

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Abstract: Due to the COVID-19 pandemic, there has been a rapid shift from traditional classroom-based education to sustainable online classrooms. This has brought attention to the importance of comprehending the intricacies of students' engagement during virtual learning. Drawing upon the concept of community of inquiry in cognitive, social, and teaching presence, a mixed-methods approach involved data collected via a structured questionnaire administered to 452 university students to identify the factors that influence students' participation during online classes. Through the application of the CHAID (Chi-Squared Automatic Interaction Detection) decision tree algorithm, the quality of course content is identified as a cognitive predictor of students' engagement. It is worth mentioning that a significant proportion of students, specifically 61.7%, demonstrated a considerable degree of engagement with faculty content due to its high quality. With respect to the role of social presence, possession of a designated private space boost (69.2%) and requiring students to use their webcams are found to be critical for students' engagement. Lastly, teaching presence as a factor in enhancing students' engagement is demonstrated by promoting interactive classrooms and providing rapid feedback to students by teachers. The findings demonstrate the importance of teachers' quality course material, interactive classes, and the benefits of a physical environment free from distractions for optimizing students' engagement.

Keywords: students' engagement; sustainable online learning; CHAID



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1. Introduction

The significance of creating sustainable online classes cannot be overemphasized. Such classes has been found to offer numerous benefits, including lower costs, flexibility in scheduling, comfort, enhanced communication, and the opportunity for self-paced learning [1]. This mode of learning is in line with wider environmental objectives. Ref. [2] emphasizes that online learning reduces carbon emissions from commuting and the physical infrastructure of traditional classrooms, thus promoting environmental sustainability. Furthermore, the COVID-19 pandemic has underscored the importance of flexibility and the possibilities that online learning offers students. According to a study by [3], the majority of students prefer to continue with online learning post-pandemic. Thus, sustainable online classes, supported by strong technological infrastructure and digital literacy, offer educational institutions the necessary flexibility to respond to unexpected challenges. Furthermore, the importance of online education's accessibility cannot be overstated. Ref. [4]

found that sustainable online classes can help address geographical and socioeconomic disparities, providing opportunities for underserved populations. In summary, sustainable online classes offer advantages in terms of environmental impact and inclusivity. They have a crucial role in maintaining the accessibility and effectiveness of education in a constantly evolving world.

Student engagement refers to the active involvement of students in their learning process, which is influenced by their actions and the supportive environment created by educational institutions [5]. Student engagement in online classes is a crucial factor that predicts the sustainability of virtual education [6], as it has a significant influence on learning outcomes and overall effectiveness. Research has demonstrated the significance of student engagement in multiple aspects. Engaged students demonstrate increased motivation and persistence, resulting in higher rates of course completion [7] and improved academic performance [8]. Moreover, there is a positive relationship between engagement and higher levels of student retention and satisfaction, which can lead to favorable sustainability of the program [9]. Active learning strategies play a crucial role in promoting student engagement, maintaining their interest, and stimulating their participation [10]. Additionally, the establishment of a robust social presence and fostering a sense of community in online learning environments have been found to have a positive association with student engagement, thus contributing to a supportive and successful online education experience [11].

Complementing ICT infrastructure, the quality and delivery of faculty content have a direct bearing on students' online participation levels [12]. Teachers' content encapsulates various elements, including the quality and relevance of teaching materials, the degree and effectiveness of teacher–student interaction, the teacher's ability to address and resolve student doubts, audio quality during online classes, the provision of necessary and relevant educational resources, and the efficiency and fairness of student evaluation methods [13]. Each of these factors contributes to a student's learning experience, influencing their level of engagement and participation in online classes [14]. The crux of effective online education lies in the symbiotic relationship between ICT infrastructure and teachers' content. The absence of a reliable ICT infrastructure can render even the most meticulously prepared and high-quality course content ineffective. In such a case, students may face barriers to accessing and understanding educational content, leading to reduced participation [15]. On the other hand, even with the best ICT infrastructure in place, if the course content is of poor quality or is not delivered effectively, it can result in lower student engagement and participation [16].

Given the importance of sustainable online classes with respect to environmental impact, educational resilience, and inclusivity in the Indian context, this study intends to investigate and identify the critical aspects impacting students' engagement. This study, which makes use of a mixed-methods approach, aims to assess the influence of social, cognitive, and teaching factors on the degree of student engagement in online education. By utilizing the CHAID decision tree algorithm, this study will furnish practical insights that can assist institutions and educators in refining their online educational offerings to foster greater student engagement and participation. Moreover, this research is significant as it addresses the essential need for sustainable and inclusive online education in India, a context with diverse and unique challenges. The present study commences by laying down a theoretical and conceptual framework, which is followed by a comprehensive review of pertinent literature. This is followed by a detailed description of the methodology adopted, an analysis of the results, and a thorough discussion of the findings. The study concludes with a summary and critical evaluation of the outcomes, encapsulating the key insights gleaned from the research. In this paper, the terms 'faculty content', 'teacher content', and 'course content' are used interchangeably and refer to the same concept.

2. Theoretical Framework

Comprehending students' engagement in sustainable online classes is crucial for informing research and practice in the field of online education. The "Community of

Inquiry” (CoI) model, developed by [17], identifies three key factors that contribute to meaningful and sustainable online learning: cognitive presence, social presence, and teaching presence. Cognitive presence encompasses the active intellectual participation and critical thinking abilities of students, which are essential for fostering enduring learning outcomes. Social presence is crucial for fostering a sense of community and interaction among learners, thereby enhancing their ongoing engagement and satisfaction. Teaching presence encompasses the instructor’s role in facilitating learning and fostering a supportive online environment. Educators and institutions can design online courses that promote engagement, deep learning, and sustainability by considering these elements. Thus, educators can enhance online learning environments by integrating components of the Community of Inquiry framework. Interactive elements such as discussion forums, real-world problem-solving, and collaborative projects contribute to cognitive presence, promoting critical thinking and the practical application of knowledge. Social presence is strengthened through group activities and peer interactions, using the Learning Management System (LMS) for a more inclusive environment. Teaching presence is enhanced by educators’ active engagement and the use of diverse digital tools, which facilitate the accommodation of different learning styles [18]. Online courses can promote deep learning and align with sustainability goals by prioritizing elements such as optimizing resource utilization and minimizing environmental consequences.

3. Literature Review

Sustainable online classes are a prominent area of interest in contemporary education due to their environmentally responsible practices, economic efficiency, and pedagogical effectiveness. Ref. [19] examines the environmental impact of virtual classrooms, specifically in terms of reducing carbon footprints through decreased commuting and physical infrastructure requirements. Ref. [20] found that online education can lead to cost savings for institutions and students, which is important for long-term economic sustainability. Pedagogical effectiveness is crucial in online learning environments, as emphasized by [21]. They stress the significance of instructional design [22], learner support [23], and interactivity [24] in creating strong online learning environments. Ref. [25] emphasizes the importance of inclusivity and access in sustainable online classes. They advocate for the use of open educational resources and learner-generated content to improve accessibility and inclusivity. Sustainable online classes encompass environmental, economic, and pedagogical factors, providing a comprehensive approach to contemporary education that balances efficiency, effectiveness, and ecological accountability.

Student engagement is a crucial aspect of education, involving the active participation of students in meaningful learning activities. According to [26], student engagement encompasses more than just attending classes and includes the amount of time and effort students dedicate to their educational pursuits. Ref. [27] provided a comprehensive categorization of engagement, which includes behavioral, emotional, and cognitive dimensions, thus offering a multifaceted understanding of the concept. Engagement is widely recognized as a crucial factor in academic performance. Ref. [28] stressed its positive association with improved grades and enhanced learning experiences. Numerous studies have examined the impact of factors such as teacher–student relationships [29], classroom environment [30], and instructional methods [31] on engagement. Ref. [17] introduced the Community of Inquiry framework, emphasizing the significance of interaction and collaboration in online learning. Ref. [32] suggests interventions that promote engagement through learning communities and high-impact practices. Ref. [33] highlighted the significance of cultural and contextual factors in engagement, underscoring the importance of implementing culturally responsive teaching practices. In summary, student engagement is a complex concept that has a significant impact on academic achievements and the overall quality of education. It is influenced by various factors and interventions.

The influence of private rooms on student engagement in online classes has received considerable attention, particularly in the context of the widespread shift to remote learning,

particularly during the COVID-19 pandemic. Research has provided significant insights in this area. Private rooms improve students' concentration and focus during online classes, minimizing distractions and promoting engagement with course materials [34]. Furthermore, private spaces in educational settings provide students with psychological comfort and security, leading to reduced stress levels and improved emotional well-being. This, in turn, has a positive impact on student engagement [35]. Private rooms reduce social distractions in shared living spaces, allowing students to create a controlled environment that minimizes interruptions and enhances their engagement with virtual classrooms [36]. Having a private room promotes active participation and interaction in online learning by creating a comfortable and confident space for students to express their ideas. This contributes to a more interactive and engaging virtual learning environment [37]. Private rooms have a significant impact on students' engagement in online classes. They enable concentration, improve well-being, reduce distractions, and enhance participation, ultimately optimizing students' online learning experiences.

A comparative analysis across different countries reveals varied challenges and enablers in the success and failure of sustainable online learning during the COVID-19 pandemic. Ref. [38] identifies four key areas in the United States: accessibility (physical and digital), usability (technology and instructional designs), wellness (physical, mental, social, and emotional health), and support systems (home, school, and peers). These factors highlight the complex nature of the challenges associated with online learning in the United States. In contrast, Ref. [39] identifies distinct concerns in Saudi Arabia, including stress, anxiety, limited time and support, technical difficulties, inadequate technical skills, and challenges related to cost and internet connectivity. These factors suggest a greater focus on the psychological and infrastructural difficulties experienced by learners in Saudi Arabia. Ref. [40] examines the association between learner characteristics and satisfaction with online learning in Pakistan. The key factors identified in this study are computer usage comfort, self-motivation, confidence, and time spent on the computer. This perspective posits that personal attributes and skills play a significant role in determining the effectiveness of online learning in the Pakistani context. This literature synthesis examines the contextual factors that influence the success and challenges of sustainable online learning in the USA, Saudi Arabia, and Pakistan. Various factors, including technological infrastructure, educational design, and individual psychological and emotional states, significantly influenced the online learning experience during the pandemic. Gaining a comprehensive understanding of these various perspectives is essential in order to create inclusive and flexible online education models on a global scale.

In the context of online education in India, the design and delivery of content are of utmost significance. According to [41], it is essential to align course content with students' interests and goals in order to promote engagement in a virtual environment. The digital format requires educational content that is both pedagogically sound and engaging, while also being easily accessible. According to [42], incorporating multimedia elements and interactive modules can enhance engagement and improve the learning experience. Effective content delivery is crucial for maintaining student focus and motivation in an asynchronous learning setting [43]. The importance of instructional design increases when creating digital content that is both easy to navigate and understand.

The influence of teachers' content on students' engagement in online classes is a crucial element of successful virtual education, as demonstrated in numerous studies. According to [44], the significance of course content in relation to student engagement lies in its alignment with students' interests and goals. When content is relevant to students, it encourages active participation and fosters meaningful learning experiences. Ref. [45] state the importance of clear and organized content delivery for increasing engagement. Additionally, Ref. [46] suggests that incorporating multimedia elements can further enhance content engagement. Additionally, research has shown that integrating collaborative activities, group discussions, and peer interaction in the classroom enhances students' engagement with the material presented by teachers [47,48]. Moreover, requiring students

to use webcams is important for maintaining their attention to the course content and allowing teachers to observe and assess their understanding and progress through visual cues such as facial expressions, hand raises, eyebrow raises, and head poses [49–51]. Similarly, there is evidence that demonstrates that feedback from teachers is critical in terms of making the feedback regular and providing it through video instead of text so that the teaching and social presence of the teacher can facilitate learners' engagement [52,53]. Lastly, a scholar investigate the role of teachers' enthusiasm in students' engagement [54]. When instructors demonstrate enthusiasm for the course content, it can greatly impact student engagement, leading to increased participation and a more thorough understanding of the material. In summary, the selection of content, methods of presentation, and level of enthusiasm displayed by teachers have a substantial impact on students' engagement in online classes, leading to enhanced learning experiences and outcomes.

Numerous studies have established the effect of several factors on students' engagement during online classes. However, it is worth noting that insufficient consideration has been given to the role of cognitive, teaching, and social presence within the framework of community of inquiry. Therefore, the primary inquiries of this investigation are as follows:

1. What is the effect of cognitive presence on students' engagement?
2. What is the effect of social presence on students' engagement?
3. What is the effect of teaching presence on students' engagement?

4. Methodology

4.1. The Research Design

In this study, the primary objective was to develop a predictive model that would accurately estimate the degree of student participation during online classes in the era of the COVID-19 pandemic. The shift from traditional in-person teaching to remote online learning has been a significant change, and understanding the dynamics of student participation in this new environment is critical. The term "participation" here encompasses a variety of behaviors, including but not limited to, attending classes, actively engaging in class discussions, submitting assignments on time, and interacting with peers and teachers virtually. The research used a mixed-methods methodology as recommended by [55], integrating both closed- and open-ended questionnaires. Closed-ended questions are effective in enabling quantitative analysis as they organize data in a manner that allows for the identification of trends, patterns, and statistical correlations. On the other hand, open-ended questions play a crucial role in qualitative research as they facilitate the process of conducting theme analysis on textual data. This approach allows researchers to gain valuable insights into the experiences, perceptions, and opinions of the participants.

4.2. Participants

As shown in Table 1, the participants of this study are Indian university students from different states of India who have shifted to online education after the COVID-19 pandemic. Out of the 452 respondents, the majority are enrolled in undergraduate courses (401), whereas the rest are postgraduate students (41) and diploma students (10). The gender distribution of students shows a higher number of males (285) compared to females (167). The distribution of students across different types of areas is as follows: 64.3% in urban areas, 18.9% in semi-urban areas, and 16.8% in rural areas. Autonomous institutions have the highest enrolment (176 students), followed by private universities (122), private affiliated institutions (53), state universities (59), and those deemed to be universities (42). In evaluating the computer proficiency of these students, the majority demonstrate an intermediate level (234 students), followed by 170 students with a basic level, and a smaller group of 48 students with an advanced level. The distribution of students in India transitioning to online learning reflects their diverse backgrounds and abilities.

Table 1. Socio-demographic profile of the participants.

Course Type	Frequency	Percentage
Post Graduate	41	9.070796
Under Graduate	401	88.71681
Diploma	10	2.212389
Total	452	100
Gender	Frequency	Percentage
Male	285	63.0531
Female	167	36.9469
Total	452	100
Institute Type	Frequency	Percentage
Autonomous Institution	176	38.93805
State Universities	59	13.0531
Deemed to be University	42	9.292035
Private Affiliated Institutions	53	11.72566
Private Universities	122	26.99115
Total	452	100
Computer Proficiency	Frequency	Percentage
Advanced Level	48	10.61947
Basic Level	170	37.61062
Intermediate Level	234	51.76991
Total	452	100

Questionnaire

The questionnaire design for the study was based on a thorough review of relevant literature, focusing on frameworks and models related to online learning engagement. Specifically, the study drew inspiration from [56] research on cognitive, social, and teaching presence. The questionnaire used in this study was based on the [57] instrument. It assessed student-content interactions, with a focus on engagement factors such as realistic scenarios, reflective prompts, multimedia materials, and student agency. Cognitive presence was measured using a three-item scale that involve rating of lesson material, video and audio material, while social presence was assessed using a single-item scale developed by [34], which considered the influence of physical home learning environments by probing the availability of private space for online classes.

The questionnaire utilized different response scales to enhance precision. These included Likert scales for evaluating perceptions, which ranged from “tough” to “joyful”, “poor to sufficient”, and “active to inactive”. Additionally, nominal scales were used for categorical data, such as “yes-no”. The subscale scores were averaged and transformed into a 1–3 scale, with higher values indicating stronger perceptions.

An open-ended question that explores the participants’ view about online learning was included to capture the teaching presence dimension and gain deeper insights into participants’ experiences in online classes. The instrument was pilot tested before deployment to ensure clarity, lack of ambiguities, and appropriate length and format, following best practices [58]. The feedback from the pilot phase was utilized to improve the questionnaire, ensuring its adherence to academic standards and enabling potential validation studies through comparison with existing measures.

4.3. Data Collection

Convenience sampling was employed in the study due to its cost-effectiveness and the ease of access to subjects for the researcher. This sampling method employs a non-probability approach by selecting participants solely based on their availability without taking into account their representation within the larger population [59]. 482 participants were invited to participate in the survey through email, which provided them with a direct link to access the survey at their convenience. A follow-up email was sent one week after the initial invitation in order to enhance response rates. The survey had a duration of two weeks, allowing participants ample time to provide their responses. To enhance the response rate, periodic reminders were sent, emphasizing the importance of participants' contributions and addressing any potential oversight in the initial invitation. The use of this digital methodology allowed for the efficient distribution and collection of survey responses. The survey platform used enabled real-time tracking of responses, enhancing the efficiency of data collection.

4.4. Data Analysis Technique

The data analysis set with an initial screening of the data to ensure that the responses were consistent and followed the expected formats, as described by [60]. During this stage, outliers were identified and handled appropriately to ensure the integrity of the analysis. The study utilized CHAID (Chi-Squared Automatic Interaction Detection) for detailed data segmentation and stratification. CHAID is effective in identifying variable interactions and uncovering complex relationships, providing a more comprehensive understanding compared to conventional descriptive analysis. Ref. [61] describes a technique that employs a decision tree structure. This structure allows for intuitive and visual analysis of data interactions, making it easier to identify distinct sub-groups. IBM SPSS software version 25 was selected due to its accessibility and user-friendly nature for conducting CHAID analysis.

Concurrently, the qualitative data obtained from open-ended questionnaires underwent a systematic analysis. The study included conducting a thematic analysis to identify patterns, themes, and variations using Maguire's methodology [62]. Text segments were assigned codes and subsequently grouped into broader themes. Regular team meetings were held to ensure intercoder reliability, which is essential for maintaining the consistency and accuracy of the qualitative analysis.

5. Analysis and Results

As shown in Figure 1, Starting at Node 0, the AI system classifies a student's level of participation (high, moderate, or low) based on the teachers' content, which is the primary predictive variable according to a chi-square statistical test result ($\chi^2 = 93.906$; $p = 0.000$; $df = 4$). When the faculty content is 'good', the system moves to Node 3. Here, it designates 61.7% of students as having a high level of participation, 32.2% as having moderate participation, and 6% as having low participation. At Node 3, a secondary predictive variable, 'Separate Room', is evaluated. This variable assessment is carried out via another chi-square test ($\chi^2 = 6.614$; $p = 0.037$; $df = 2$), which results in the creation of two terminal nodes, Nodes 4 and 5. Node 4 includes students without a separate room for online classes, whereas Node 5 consists of students who have a separate room. Interestingly, both these nodes have a majority of students showing a high level of participation: 51.3% in Node 4 and 69.2% in Node 5. Furthermore, if the course content is assessed as 'excellent/very good', the level of participation is high (80.6%) as shown in Node 2. Conversely, if the content is 'poor or fair', the level of participation tends to be low (31.6%) or moderate (3.6%), as demonstrated in Node 1. Lastly, a segment of students showing a low level of participation comprises roughly a fifth (15%) of the total sample. A further breakdown reveals that despite having 'excellent', 'good', and 'poor' course content, these students' participation rates were 3.1%, 6%, and 31.6%, respectively.

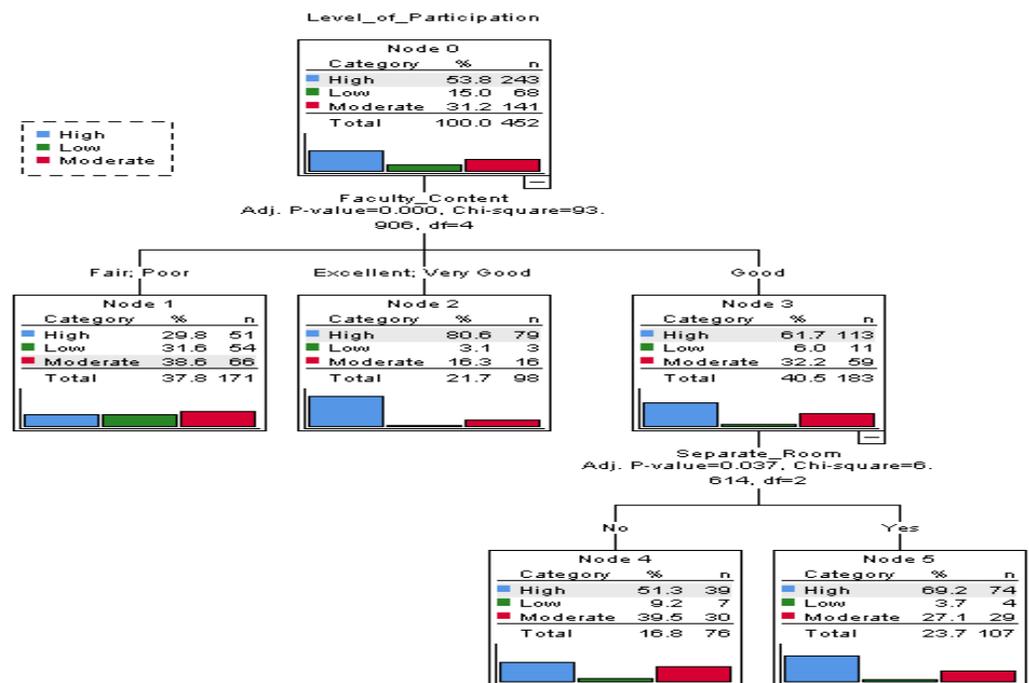


Figure 1. CHAID algorithm output.

From our CHAID analysis, this study found that the most influential predictor of student participation level is the quality of the course content. This accounts for the cognitive-dimensional impact of students' engagement. Particularly when the faculty content is rated as 'good' in terms of audio, video, and delivery, the study showed that over 61.7% of students are likely to have a high level of participation. This presents an opportunity to discuss the importance of the quality of faculty content in determining student engagement in online learning environments. Course members need to ensure their content is engaging, relevant, and rich to motivate student interaction. It also suggests the potential benefit of teacher development programs that help educators design and deliver 'good' or even 'excellent' online content.

The second predictor which accounts for the social presence dimension is the role of having a 'Separate Room' for online learning. Within the 'good' course content group, the level of participation was notably higher among students who had a separate room for their online classes (69.2% high level of participation) than those without (51.3%). This finding encourages further discussion about the role of a conducive learning environment in student participation. A separate room potentially provides a quiet, distraction-free environment that could enhance student focus and participation in online classes. Additionally, our findings show that the compulsory use of webcams is another social factor that boosts student engagement in online classes. This is a notable theme that emerged from the open-ended questionnaire. This practice, which teachers have mandated, seems to promote a more open and interactive learning environment. Several participants highlighted this aspect, with one student explicitly stating, "Teachers ask students to turn on their cameras, making it mandatory". This requirement for camera usage seems to create a sense of presence and accountability among students, thereby actively contributing to their engagement in the educational process. This finding underscores the potential of visibility tools, such as webcams, to replicate the interactive elements of traditional classroom settings within a virtual context.

A primary theme that emerged from the data is the significant role of interactive classroom environments in promoting student engagement in online settings. This theme aligns with the dimension of teaching presence, which encompasses the design, facilitation, and direction of cognitive and social processes for educational outcomes. Participants frequently cited the dynamic approach of teachers to creating lively classroom experiences.

One student elaborated, “Teachers promote engagement by making class lively through discussions, quizzes, PowerPoint presentations, and some practical approaches”. Such strategies, as highlighted by respondents, are indicative of a strong teaching presence that actively engages students and enhances their learning experience. Another distinct theme that surfaced is the importance of rapid feedback from teachers in fostering student engagement. This aspect is also reflective of the teaching presence framework, specifically in the realms of effective instructional design and facilitation. Participants emphasized the value of timely responses to their queries, both during and after class sessions. As one student articulated, “Rapid feedback to students’ questions during and after class is crucial”. This finding underscores the significance of immediate feedback in online learning environments, which not only addresses students’ academic needs but also contributes to a more engaging and responsive educational experience.

6. Discussion

Numerous studies have demonstrated the significant impact of teachers’ content as a cognitive factor that fosters students’ engagement in online classes, which is consistent with our own research findings. According to [44], aligning course content with students’ interests and goals is crucial for promoting engagement. Our research findings indicate that when instructors customize their content to align with students’ preferences and aspirations, it leads to increased engagement in discussions, assignments, and coursework. This alignment fosters a perception of relevance among students, as they view the material as directly applicable to their lives and future pursuits. Therefore, this increased sense of importance encourages students to dedicate more time and effort to their studies, which is consistent with [26] definition of engagement as the “time and effort students put into educationally meaningful activities”. Ref. [45] underscore the significance of delivering content in a clear and organized manner to enhance engagement, a claim that our research findings support. When instructors present course materials in an organized and coherent manner, it enhances students’ understanding and ability to navigate the course, thereby reducing cognitive load and potential frustration. This facilitates students’ ability to concentrate on the content and actively participate in it. Our research aligns with the [46] proposal to integrate multimedia elements for the purpose of enhancing content engagement. Our observations suggest that incorporating well-designed multimedia elements, such as videos, simulations, and interactive assessments, enhances engagement and accommodates various learning styles and preferences. Multimedia enhances understanding of complex concepts and sustains student interest, aligning with the cognitive engagement dimension identified by [27]. Our research suggests that instructors who demonstrate passion and expertise in their subject matter have the ability to inspire students and foster a welcoming and positive learning environment [54]. This enthusiasm has the potential to spread, inspiring students to engage actively in discussions, inquire, and delve into the subject matter in greater depth. In summary, the alignment of content with students’ interests, clear and organized content delivery, the integration of multimedia elements, and instructor enthusiasm all play a role in fostering student engagement in online classes. Our research findings support the significance of these factors in facilitating meaningful and productive virtual learning experiences, thereby improving students’ learning outcomes and the overall quality of online education.

Studies have also established the importance of private rooms as a social factor in increasing student engagement in online classes, which is in line with our own research findings. According to [34], private rooms have a significant positive impact on students’ concentration and focus in online classes. They help minimize distractions and enhance students’ engagement with course materials. Our research supports this claim, indicating that students who are in private rooms show greater levels of sustained attention and active participation in virtual classrooms. The establishment of a dedicated and quiet learning environment enables students to fully engage in their studies, reducing external distractions and fostering focused concentration. Ref. [35] elucidate the importance of

private spaces in educational settings for promoting psychological comfort and security. These spaces contribute to lower stress levels and enhanced emotional well-being. Our research aligns with this perspective, as we have found that students with private rooms frequently experience reduced stress and anxiety related to online learning. Emotional well-being enhances students' overall engagement by fostering a positive and confident mindset towards their coursework. Our research also aligns with [36] in highlighting the importance of minimizing social distractions in private rooms. Living with roommates can lead to interruptions that disrupt students' participation in online classes. On the other hand, students who have private rooms at their disposal can establish a controlled and uninterrupted setting, which facilitates their complete engagement in the virtual learning process. Our research supports the findings of [37], indicating that having a private room promotes engagement and interaction in online learning. Students in private rooms feel more comfortable and confident, leading to increased interaction and engagement in virtual learning. This interaction benefits students individually and contributes to a dynamic and collaborative online classroom, enhancing the overall learning experience. Thus, private rooms are crucial for enhancing student engagement in online classes, creating an environment conducive to increased engagement, enhancing learning outcomes, and promoting the long-term sustainability and effectiveness of virtual learning. Furthermore, our findings revealed that obligatory utilization of webcams by teachers can be used as a social factor to enhance students' engagement in online learning environments. This observation aligns with prior studies [42–44] that have demonstrated the importance of mandating the use of webcams in keeping students engaged with course content. Webcams in online classes enhance social presence, addressing a common deficiency in virtual learning environments. This presence is essential for multiple reasons. Firstly, it enables real-time visual interaction that replicates the dynamics of an in-person classroom. Our findings highlight the invaluable role of teachers in observing and assessing students' understanding through visual cues such as facial expressions, hand raises, eyebrow raises, and head poses. Non-verbal cues provide teachers with prompt feedback on student comprehension, allowing them to adapt their teaching methods accordingly. The literature indicates that webcam use improves students' sense of belonging and connectedness in the virtual classroom [42–44]. Social presence has been found to enhance engagement and potentially enhance learning outcomes. Peer visibility promotes a sense of community and collaboration among students, which is crucial for a holistic learning experience. Nevertheless, it is imperative to acknowledge the possible obstacles and privacy issues linked to obligatory webcam utilization.

The study's findings emphasize the importance of teaching presence in improving student engagement in online courses. This is consistent with previous studies that have shown the efficacy of interactive classroom environments and prompt feedback in online learning contexts [40,41,45,46]. Our study supports the significance of establishing interactive classroom environments, which aligns with previous research [40,41], highlighting the value of incorporating collaborative activities, group discussions, and peer interactions. Interactivity in virtual learning spaces promotes student engagement and cultivates a sense of community and collaboration. The pedagogical implication is that educators should incorporate interactive elements into their online courses, moving away from traditional lectures and adopting more dynamic and participatory teaching methods. Additionally, our research highlights the importance of prompt feedback provided by educators. Prior research has indicated that providing regular feedback, especially through video rather than text, has a significant positive impact on teaching and social presence, leading to increased student engagement [45,46]. This indicates a necessity to change the approach to providing feedback in online education. Educators should receive appropriate training and resources to deliver prompt and diverse feedback, utilizing video tools to enhance the personalization, engagement, and effectiveness of their responses. The emphasis on interactive environments and prompt feedback has substantial implications for online teaching methods. This implies a requirement for professional development initiatives that

provide teachers with the necessary skills and tools to effectively design engaging online learning experiences. The training encompasses instruction in digital tools for interactivity, strategies for promoting peer-to-peer interaction, and methods for delivering multimedia feedback efficiently. While the integration of advanced technology tools and methods is advantageous, it is imperative to also prioritize the accessibility of these tools for all students. The digital divide presents a challenge for educators, who must be mindful in their selection of tools and methods to avoid unintentionally excluding or disadvantaging specific student groups.

The Community of Inquiry (CoI) theory emphasizes the importance of cognitive, social, and teaching presences in promoting student engagement in online classes [17]. Our findings align with this framework, highlighting the significance of each presence in establishing a successful online learning environment. Cognitive presence, a key aspect of Community of Inquiry (CoI), is enhanced by the teachers' delivery of high-quality content. Our study emphasizes the positive impact of instructors offering engaging and interesting content, which promotes critical thinking and facilitates profound learning. Cognitive presence is crucial for student engagement as it promotes intellectual involvement with course content, resulting in enhanced comprehension and knowledge retention. The quality of content engages students cognitively and supports the sustainability of learning by reinforcing concepts in their minds. Our research also highlights the significance of private rooms in augmenting social presence. Offering students individualized spaces for online classes is essential for increasing student engagement. This space provides a tranquil and undisturbed setting, which is essential for sustaining concentration and active engagement. This environment promotes an optimal learning atmosphere, enabling students to fully engage in class activities such as discussions, and absorb course material more efficiently, resulting in a more comprehensive educational experience. Our study found that interactive classes and prompt feedback from teachers are important, which is consistent with the teaching presence in the Community of Inquiry (CoI) model [18]. Interactive classes, comprising discussions, group activities, and practical exercises, promote student engagement and facilitate immediate assessment of comprehension. Timely feedback is essential for maintaining student progress and motivation. It offers prompt guidance and clarification, thereby enhancing the learning experience.

In summary, the sustainable engagement of students in online classes is closely linked to the development of cognitive, social, and teaching presences. Our research findings provide support for the CoI framework, indicating that achieving a balanced integration of these three presences is crucial in order to establish an online learning environment that is both engaging and successful. This comprehensive approach not only promotes immediate student involvement but also cultivates a more profound and enduring connection with the course content.

Overall, the Indian study's focus on teacher-driven factors and structured learning environments offers a contrast to the U.S. emphasis on broader support systems [38], Saudi Arabia's focus on psychological and technical challenges [39], and Pakistan's attention to individual learner characteristics [40]. This comparison illustrates the diverse and context-specific nature of challenges and enablers in sustainable online learning, highlighting those different regions may require tailored approaches to optimize student engagement and learning outcomes.

The introduction emphasizes the potential of CHAID (Chi-Squared Automatic Interaction Detection) as a valuable tool in educational assessment, specifically in enhancing the precision and efficacy of evaluating student performance and educational outcomes. This discussion explores the effectiveness of CHAID in relation to our research findings on the influence of teachers' content and learners' private rooms on student engagement in online classes. It demonstrates how CHAID can improve assessment practices and provide insights for instructional strategies. CHAID is a powerful statistical technique that employs decision tree analysis to reveal complex patterns and relationships in educational datasets. In our study, the CHAID method was highly valuable for evaluating the impact of teacher

content and private rooms on student engagement. It enabled us to identify important variables and interactions that had a significant effect on students' levels of engagement. Our study demonstrates the effectiveness of CHAID in identifying underlying factors that influence student achievement. This aligns with the findings of [63]. By using CHAID, educators and institutions can gain detailed insights to make data-driven decisions, implement personalized interventions, and enhance educational quality.

The importance of developing sustainable online classes is emphasized in multiple studies and supported by research findings [2,4]. This highlights the crucial role that students' private physical environment and teachers' course content play in promoting engagement, which is vital for the long-term viability of online education. Ref. [2] highlights the potential of online learning to decrease carbon emissions and support environmental goals. However, in order for students to effectively contribute to sustainability efforts, it is crucial for them to have a comfortable and environmentally conscious private physical space. These spaces enable students to concentrate on their academic pursuits and embrace environmentally sustainable behaviors. Ref. [3] found that digital tools for online teaching play a crucial role in providing learning flexibility to students, thereby shaping preferences for online learning. These elements are essential for the long-term success and sustainability of online education, especially in addressing geographical and socioeconomic disparities and improving accessibility for underserved populations [4].

7. Conclusions

The aim of this study was to identify three key predictors of students' engagement that are critical for sustainable online classes. The integral role of teachers' content, a conducive learning environment, and interactive classes were found to be strong predictors of student engagement. In other words, the significance of this study lies in revealing that sustainable online learning is only possible if students' engagement is highly supported by good content from teachers, having access to a private, conducive environment and pedagogical practices that promote interaction in the classroom. Based on the study's findings, it is recommended that educators prioritize high-quality content delivery and the deployment of pedagogical approaches that stimulate active interaction in the classroom. Teachers and institutions should facilitate resources to ensure students access to private, conducive learning spaces, enhancing engagement and sustainability in online classes. The study's primary limitation is the adoption of a single-item scale for one dimension in Chi-Squared Automatic Interaction Detection (CHAID), which raises the possibility of decreased measurement reliability and validity. This can restrict the depth and accuracy of interaction analysis, especially in complex multivariate situations. Further research should investigate the incorporation of multi-item scales into Chi-Squared Automatic Interaction Detection (CHAID) analysis in order to improve the reliability and validity of measurements. Examining the effects of comprehensive scales on the accuracy and depth of interaction analysis in complex, multivariate contexts would be a valuable endeavor. Furthermore, conducting comparative studies that examine the use of single-item and multi-item scales in CHAID analysis could offer a more comprehensive understanding of the advantages and disadvantages associated with each approach in various research contexts. Lastly, regarding the relevance of webcams in online learning, future research should prioritize the development of privacy-preserving technologies for webcams in online educational settings, with a specific emphasis on finding a suitable equilibrium between promoting educational engagement and ensuring personal security.

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References

1. Al Rawashdeh, A.Z.; Mohammed, E.Y.; Al Arab, A.R.; Alara, M.; Al-Rawashdeh, B. Advantages and Disadvantages of Using E-Learning in University Education: Analyzing Students' Perspectives. *Electron. J. E-Learn.* **2021**, *19*, 107–117. [\[CrossRef\]](#)
2. Yin, Z.; Jiang, X.; Lin, S.; Liu, J. The Impact of Online Education on Carbon Emissions in the Context of the COVID-19 Pandemic—Taking Chinese Universities as Examples. *Appl. Energy* **2022**, *314*, 118875. [\[CrossRef\]](#) [\[PubMed\]](#)
3. Zheng, M.; Bender, D.; Lyon, C. Online Learning during COVID-19 Produced Equivalent or Better Student Course Performance as Compared with Pre-Pandemic: Empirical Evidence from a School-Wide Comparative Study. *BMC Med. Educ.* **2021**, *21*, 495. [\[CrossRef\]](#) [\[PubMed\]](#)
4. Rosen, Y.; Wolf, I. Bridging the Social Gap through Educational Technology: Using the Time to Know Digital Teaching Platform. *Educ. Technol.* **2011**, *51*, 39–43.
5. Kuh, G.D. The National Survey of Student Engagement: Conceptual and Empirical Foundations. *New Dir. Institutional Res.* **2009**, *141*, 5–20. [\[CrossRef\]](#)
6. Peng, W. Research on Model of Student Engagement in Online Learning. *Eurasia J. Math. Sci. Technol. Educ.* **2017**, *13*, 2869–2882. [\[CrossRef\]](#)
7. Suresh Kumar, S.; Mallikarjuna Shastry, P. Analysis of Student Engagement and Course Completion in Massive Open Online Courses. In *Integrated Intelligent Computing, Communication and Security*; Springer: Singapore, 2019; pp. 447–458.
8. Kuzminykh, I.; Ghita, B.; Xiao, H. The Relationship between Student Engagement and Academic Performance in Online Education. In Proceedings of the 2021 5th International Conference on E-Society, E-Education and E-Technology, Taipei, Taiwan, 21–23 August 2021; pp. 97–101.
9. Chen, H.L.; Lattuca, L.R.; Hamilton, E.R. Conceptualizing Engagement: Contributions of Faculty to Student Engagement in Engineering. *J. Eng. Educ.* **2008**, *97*, 339–353. [\[CrossRef\]](#)
10. Munna, A.S.; Kalam, M.A. Impact of Active Learning Strategy on the Student Engagement. *GNOSI Interdiscip. J. Hum. Theory Prax.* **2021**, *4*, 96–114.
11. Jorge, I. Social Presence and Cognitive Presence in an Online Training Program for Teachers of Portuguese: Relation and Methodological Issues. In Proceedings of the International Joint Conference and Media Days, Valencia, Spain, 20–23 January 2010; pp. 427–436.
12. Kunal, A.; Nayak, A. A Study on Perception of Teachers and Students toward Online Classes in Dakshina Kannada and Udupi District. *Asian Assoc. Open Univ. J.* **2020**, *15*, 285–296. [\[CrossRef\]](#)
13. Frei-Landau, R.; Avidov-Ungar, O. Educational Equity amidst COVID-19: Exploring the Online Learning Challenges of Bedouin and Jewish Female Preservice Teachers in Israel. *Teach. Teach. Educ.* **2022**, *111*, 103623. [\[CrossRef\]](#)
14. Bordoloi, R.; Das, P.; Das, K. Perception towards Online/Blended Learning at the Time of Covid-19 Pandemic: An Academic Analytics in the Indian Context. *Asian Assoc. Open Univ. J.* **2021**, *16*, 41–60. [\[CrossRef\]](#)
15. Almaiah, M.A.; Hajje, F.; Lutfi, A.; Al-Khasawneh, A.; Shehab, R.; Al-Otaibi, S.; Alrawad, M. Explaining the Factors Affecting Students' Attitudes to Using Online Learning (Madrastati Platform) during COVID-19. *Electronics* **2022**, *11*, 973. [\[CrossRef\]](#)
16. Aidoo, B.; Macdonald, M.A.; Vesterinen, V.-M.; Pétursdóttir, S.; Gísladóttir, B. Transforming Teaching with ICT Using the Flipped Classroom Approach: Dealing with COVID-19 Pandemic. *Educ. Sci.* **2022**, *12*, 421. [\[CrossRef\]](#)
17. Garrison, D.R.; Anderson, T.; Archer, W. Critical Inquiry in a Text-Based Environment: Computer Conferencing in Higher Education. *Internet High. Educ.* **1999**, *2*, 87–105. [\[CrossRef\]](#)
18. Miao, J.; Chang, J.; Ma, L. Teacher–Student Interaction, Student–Student Interaction and Social Presence: Their Impacts on Learning Engagement in Online Learning Environments. *J. Genet. Psychol.* **2022**, *183*, 514–526. [\[CrossRef\]](#) [\[PubMed\]](#)
19. Silva, D.A.L.; Giusti, G.; Rampasso, I.S.; Junior, A.C.F.; Marins, M.A.S.; Anholon, R. The Environmental Impacts of Face-to-Face and Remote University Classes during the COVID-19 Pandemic. *Sustain. Prod. Consum.* **2021**, *27*, 1975–1988. [\[CrossRef\]](#)
20. Jung, I.; Rha, I. Effectiveness and Cost-Effectiveness of Online Education: A Review of the Literature. *Educ. Technol.* **2000**, *40*, 57–60.
21. Bailey, C.J.; Card, K.A. Effective Pedagogical Practices for Online Teaching: Perception of Experienced Instructors. *Internet High. Educ.* **2009**, *12*, 152–155. [\[CrossRef\]](#)
22. Czerkowski, B.C.; Lyman, E.W. An Instructional Design Framework for Fostering Student Engagement in Online Learning Environments. *TechTrends* **2016**, *60*, 532–539. [\[CrossRef\]](#)
23. Zhao, X.; Shao, M.; Su, Y.-S. Effects of Online Learning Support Services on University Students' Learning Satisfaction under the Impact of COVID-19. *Sustainability* **2022**, *14*, 10699. [\[CrossRef\]](#)
24. Dailey-Hebert, A. Maximizing Interactivity in Online Learning: Moving beyond Discussion Boards. *J. Educ. Online* **2018**, *15*, n3. [\[CrossRef\]](#)

25. Anderson, T.; Dron, J. Three Generations of Distance Education Pedagogy. *Int. Rev. Res. Open Distrib. Learn.* **2011**, *12*, 80–97. [[CrossRef](#)]
26. Kuh, G.D.; Hu, S. The Relationship between Computer and Information Technology Use, Selected Learning and Personal Development Outcomes, and Other College Experiences. *J. Coll. Stud. Dev.* **2001**, *42*, 217–232.
27. Fredricks, J.A.; Blumenfeld, P.C.; Paris, A.H. School Engagement: Potential of the Concept, State of the Evidence. *Rev. Educ. Res.* **2004**, *74*, 59–109. [[CrossRef](#)]
28. Wang, M.; Eccles, J.S. Adolescent Behavioral, Emotional, and Cognitive Engagement Trajectories in School and Their Differential Relations to Educational Success. *J. Res. Adolesc.* **2012**, *22*, 31–39. [[CrossRef](#)]
29. Pianta, R.C.; Hamre, B.K.; Allen, J.P. Teacher-Student Relationships and Engagement: Conceptualizing, Measuring, and Improving the Capacity of Classroom Interactions. In *Handbook of Research on Student Engagement*; Springer: Berlin/Heidelberg, Germany, 2012; pp. 365–386.
30. Cooper, L.; Fry, K.F. The Relationship between Classroom Environment and Student Course Attrition and Perceptions of Engagement. *J. Learn. Spaces* **2020**, *9*, 93–102.
31. Dovale, M.M.; Aponte, Y.M.; Canales, Y.; Tejeiro, B. *The Relationship between Instructional Delivery and Student Engagement in Selected Classrooms: A Cross-Case Analysis*; The College of William and Mary: Williamsburg, VA, USA, 2020.
32. Tinto, V. *Leaving College: Rethinking the Causes and Cures of Student Attrition*; University of Chicago Press: Chicago, IL, USA, 2012.
33. Samuels, A.J. Exploring Culturally Responsive Pedagogy: Teachers' Perspectives on Fostering Equitable and Inclusive Classrooms. *Srate J.* **2018**, *27*, 22–30.
34. Keser Aschenberger, F.; Radinger, G.; Brachtl, S.; Ipser, C.; Oppl, S. Physical Home Learning Environments for Digitally-Supported Learning in Academic Continuing Education during COVID-19 Pandemic. *Learn. Environ. Res.* **2023**, *26*, 97–128. [[CrossRef](#)]
35. Sukdee, T.; Khajornsilp, J.; Netrthanon, S.; Pechsri, K.; Ayudhaya, W.S.N. Factors Affecting Stress of Online Learning Due to the COVID-19 Situation at Faculty of Education, Thailand National Sports University Chonburi Campus. *J. Curric. Teach.* **2021**, *10*, 25–33. [[CrossRef](#)]
36. Gu, J. Impact of Living Conditions on Online Education: Evidence from China. *Sustainability* **2022**, *14*, 3231. [[CrossRef](#)]
37. Limniou, M.; Sedghi, N.; Kumari, D.; Drousiotis, E. Student Engagement, Learning Environments and the COVID-19 Pandemic: A Comparison between Psychology and Engineering Undergraduate Students in the UK. *Educ. Sci.* **2022**, *12*, 671. [[CrossRef](#)]
38. An, H.; Mongillo, G.; Sung, W.; Fuentes, D. Factors Affecting Online Learning during the COVID-19 Pandemic: The Lived Experiences of Parents, Teachers, and Administrators in US High-Needs K-12 Schools. *J. Online Learn. Res.* **2022**, *8*, 203–234.
39. Abdelwahed, N.A.A.; Aldoghan, M.A.; Moustafa, M.A.; Soomro, B.A. Factors Affecting Online Learning, Stress and Anxiety during the COVID-19 Pandemic in Saudi Arabia. *Int. J. Hum. Rights Healthc.* **2022**, *16*, 437–453. [[CrossRef](#)]
40. Safdar, G.; Rauf, A.; Ullah, R.; Rehman, A.U. Exploring Factors Leading to Quality Online Learning in the Era of Covid-19: A Correlation Model Study. *Univers. J. Educ. Res.* **2020**, *8*, 7324–7329. [[CrossRef](#)]
41. Marougkas, A.; Troussas, C.; Krouska, A.; Sgouropoulou, C. Virtual Reality in Education: A Review of Learning Theories, Approaches and Methodologies for the Last Decade. *Electronics* **2023**, *12*, 2832. [[CrossRef](#)]
42. Martin, F.; Borup, J. Online Learner Engagement: Conceptual Definitions, Research Themes, and Supportive Practices. *Educ. Psychol.* **2022**, *57*, 162–177. [[CrossRef](#)]
43. Singh, J.; Evans, E.; Reed, A.; Karch, L.; Qualey, K.; Singh, L.; Wiersma, H. Online, Hybrid, and Face-to-Face Learning through the Eyes of Faculty, Students, Administrators, and Instructional Designers: Lessons Learned and Directions for the Post-Vaccine and Post-Pandemic/COVID-19 World. *J. Educ. Technol. Syst.* **2022**, *50*, 301–326. [[CrossRef](#)]
44. Gray, J.A.; DiLoreto, M. The Effects of Student Engagement, Student Satisfaction, and Perceived Learning in Online Learning Environments. *Int. J. Educ. Leadersh. Prep.* **2016**, *11*, n1.
45. Donham, C.; Pohan, C.; Menke, E.; Kranzfelder, P. Increasing Student Engagement through Course Attributes, Community, and Classroom Technology: Lessons from the Pandemic. *J. Microbiol. Biol. Educ.* **2022**, *23*, e00268-21. [[CrossRef](#)]
46. Baloran, E.T.; Hernan, J.T. Course Satisfaction and Student Engagement in Online Learning amid COVID-19 Pandemic: A Structural Equation Model. *Turk. Online J. Distance Educ.* **2021**, *22*, 1–12. [[CrossRef](#)]
47. Dixson, M.D. Creating Effective Student Engagement in Online Courses: What Do Students Find Engaging? *J. Scholarsh. Teach. Learn.* **2010**, *10*, 1–13.
48. Gaytan, J.; McEwen, B.C. Effective Online Instructional and Assessment Strategies. *Am. J. Distance Educ.* **2007**, *21*, 117–132. [[CrossRef](#)]
49. Chen, H.-R. Assessment of Learners' Attention to e-Learning by Monitoring Facial Expressions for Computer Network Courses. *J. Educ. Comput. Res.* **2012**, *47*, 371–385. [[CrossRef](#)]
50. Händel, M.; Bedenlier, S.; Kopp, B.; Gläser-Zikuda, M.; Kammerl, R.; Ziegler, A. The Webcam and Student Engagement in Synchronous Online Learning: Visually or Verbally? *Educ. Inf. Technol.* **2022**, *27*, 10405–10428. [[CrossRef](#)] [[PubMed](#)]
51. Fan, Z.; Xu, J.; Liu, W.; Liu, F.; Cheng, W. *Kinect-Based Dynamic Head Pose Recognition in Online Courses*; IEEE: Piscataway, NJ, USA, 2016; pp. 448–453.
52. Morrison, L.; Jacobsen, M. The Role of Feedback in Building Teaching Presence and Student Self-Regulation in Online Learning. *Soc. Sci. Humanit. Open* **2023**, *7*, 100503. [[CrossRef](#)]
53. Li, J.; Wong, S.C.; Yang, X.; Bell, A. Using Feedback to Promote Student Participation in Online Learning Programs: Evidence from a Quasi-Experimental Study. *Educ. Technol. Res. Dev.* **2020**, *68*, 485–510. [[CrossRef](#)]

54. Peng, C. A Conceptual Review of Teacher Enthusiasm and Students' Success and Engagement in Chinese EFL Classes. *Front. Psychol.* **2021**, *12*, 742970. [[CrossRef](#)]
55. Wasti, S.P.; Simkhada, P.; van Teijlingen, E.R.; Sathian, B.; Banerjee, I. The Growing Importance of Mixed-Methods Research in Health. *Nepal J. Epidemiol.* **2022**, *12*, 1175. [[CrossRef](#)]
56. Dixson, M.D. Measuring Student Engagement in the Online Course: The Online Student Engagement Scale (OSE). *Online Learn.* **2015**, *19*, n4. [[CrossRef](#)]
57. Martin, F.; Bolliger, D.U. Engagement Matters: Student Perceptions on the Importance of Engagement Strategies in the Online Learning Environment. *Online Learn.* **2018**, *22*, 205–222. [[CrossRef](#)]
58. Morgado, F.F.; Meireles, J.F.; Neves, C.M.; Amaral, A.; Ferreira, M.E. Scale Development: Ten Main Limitations and Recommendations to Improve Future Research Practices. *Psicol. Reflex. E Critica* **2017**, *30*. [[CrossRef](#)] [[PubMed](#)]
59. Simkus, J. Convenience Sampling: Definition, Method and Examples. Retrieved Oktober **2022**, *6*, 2022.
60. Meijer, R.R.; Niessen, A.S.M.; Tendeiro, J.N. A Practical Guide to Check the Consistency of Item Response Patterns in Clinical Research through Person-Fit Statistics: Examples and a Computer Program. *Assessment* **2016**, *23*, 52–62. [[CrossRef](#)] [[PubMed](#)]
61. van Diepen, M.; Franses, P.H. Evaluating Chi-Squared Automatic Interaction Detection. *Inf. Syst.* **2006**, *31*, 814–831. [[CrossRef](#)]
62. Maguire, M.; Delahunt, B. Doing a Thematic Analysis: A Practical, Step-by-Step Guide for Learning and Teaching Scholars. *Irel. J. High. Educ.* **2017**, *9*, 3351–33514.
63. Onoja, A.; Babasola, O.; Ojiambo, V. Chi-Square Automatic Interaction Detection Modeling of the Effects of Social Media Networks on Students' Academic Performance. *J. Stat. Math. Sci.* **2018**, *4*, 32–39.

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