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PREFERENCES IN ONLINE LEARNING OF STS: PERSPECTIVES FROM STUDENTS

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Abstract

In today's higher education setting, the integration of online learning has profoundly transformed pedagogical practices, particularly in Science, Technology, and Society (STS) education. This study investigates students' preferences for online learning in the context of STS at a state university in the Philippines. Using a researcher-developed questionnaire focused on Modality, Assessment, Relevance, and Interaction (MARIQ), the research examines various aspects of online learning methods and assessment practices. The study reveals that students prefer asynchronous learning modes and multimedia-rich content to enhance engagement and comprehension. These insights are vital for shaping curriculum design and instructional strategies, with an emphasis on the need for adaptable assessment methods and interactive learning platforms. Additionally, the study addresses challenges such as maintaining student engagement and improving technological competencies. It suggests potential areas for future research in adaptive technologies and innovative teaching approaches to further enhance STS education.

Keywords: Creative teaching-learning; Online teaching-learning; Science, Technology and Society; VAK Theory.

INTRODUCTION

Science, Technology, and Society (STS) has become an essential part of modern educational frameworks, particularly after the implementation of the K-12 educational reform in the Philippines. This integration into the university curriculum represents a strategic response to national priorities that stress the fundamental roles of science, technology, and innovation in driving economic growth and societal progress.

As outlined in the Science Framework for Philippine Basic Education (2011), STS aims to bridge scientific knowledge with technological applications while examining their complex interactions with various social, cultural, political, and economic factors. The introduction of STS courses at universities over the past four years has been designed to engage students in reflections on the impacts of science and technology on society. This interdisciplinary approach encourages students to explore how scientific advancements intersect with broader societal contexts, such as environmental sustainability and ethical decision-making. The curriculum mandates covering essential topics like climate change and environmental awareness, aligning with both national and global priorities.

Despite the significance of STS courses, there is a notable lack of published literature specifically evaluating STS as a General Education Course (GEC). However, various studies published its importance in preparing future professionals to tackle complex challenges in the 21st century, as supported by insights from the National Academy of Science and Technology.To address the need for a systematic assessment tool contextualized to the online teaching and learning environment in STS, the Modality, Assessment, Relevance, and Interaction Questionnaire (MARIQ) was developed. This tool was conceptualized, validated, and refined with guidance from educational theories such as the Visual-Auditory-Kinesthetic (VAK) Theory, Transformative Learning Theory, and Self-determination Theory. Expert consultations and pilot testing ensured the questionnaire's validity and reliability, resulting in a high Cronbach's alpha coefficient of 0.89, indicating strong internal consistency. The MARIQ's design reflects a comprehensive understanding of student engagement, learning preferences, and the diverse ways students interact with online content.

This study utilized IBM SPSS Statistics version 23 for thorough statistical analyses, including descriptive statistics to explain mean values and standard deviations. Survey administration was facilitated via Google Forms, integrated into the university's learning management system, enabling efficient data collection and participant engagement. A purposive sampling approach was employed, yielding responses from 241 students. This method ensured the capture of a wide range of student experiences and viewpoints, enriching the study's findings and offering valuable insights for future educational strategies.

METHODOLOGY

To develop the Modality, Assessment, Relevance, and Interaction Questionnaire (MARIQ) for analyzing the preferences of students in learning Science, Technology, and Society (STS) through online modalities, a rigorous development and validation procedure was employed. The process commenced with the conceptualization phase, during which the key constructs—modality, assessment practices, course content relevance, and interaction dynamics—were precisely defined. Building on extensive literature reviews and consultations with experts in STS education, a comprehensive pool of survey items was created to measure these constructs effectively. The content validity of these items was ensured through expert review, to capture the nuances of online learning preferences. Construct validity was further conducted using factor analysis and correlation studies, complemented by validation from three senior faculty members with substantial experience in STS education.

Pilot testing was conducted with a sample of students to refine the questionnaire, addressing any ambiguities in item wording or response options.

The reliability of the MARIQ was assessed using Cronbach's alpha, which yielded a coefficient of 0.89, indicating high internal consistency among the survey items. Ethical considerations were paramount throughout the process, ensuring the protection of participant confidentiality and rights. These ethical safeguards included secure handling of data and informed consent procedures, reinforcing the integrity of the research.

The statistical analysis for this study was performed using IBM SPSS Statistics version 23, focusing on descriptive statistics such as mean values and standard deviations. The survey was administered via Google Forms and integrated into the university's official learning management system, streamlining data collection and retrieval. This integration facilitated the efficient handling of participant responses while maintaining data integrity.

A purposive sampling strategy was employed to select participants who met specific criteria relevant to the research objectives. This approach ensured that individuals who were most likely to provide valuable insights into online Science, Technology, and Society (STS) education were included. Participants were self-selected into the study based on their alignment with the established criteria, which facilitated a targeted examination of their experiences and viewpoints.

An online survey was administered to collect data from a sample of 241 students. The survey was designed to capture a diverse perspective regarding the online teaching and learning of STS. This methodological choice was intended to include a wide spectrum of student experiences and opinions, thereby enabling a thorough analysis of their preferences and perceptions. The data collected through this survey provided a robust dataset for evaluating the effectiveness and reception of online STS instructional strategies. Throughout the research process, stringent ethical standards were adhered to, including measures to protect participant confidentiality and uphold their rights. These ethical practices were integral in ensuring the integrity of the research and the reliability of the findings.

RESULTS AND DISCUSSION

Table 1 shows the learning experiences of STS students in terms of the conduct of creative activities.

Table 1. Conduct of Creative Activities

Indicators	M	SD	DE
I learn more in the STS course when I make creative activities related to the lesson.	3.78	.447	Strongly Agree
2. I learn more in the STS course when I work with my classmates in small groups.	3.66	.556	Strongly Agree
3. I love to do activities in the STS course where I	3.68	.560	Strongly

can showcase my creativity.			Agree
4. I love to use software (Canva, Word Cloud, Adobe, MS Word, MS Publisher) to showcase my creativity.	3.75	.482	Strongly Agree
can express the concepts I understand about STS by creating visual outputs like infographics, photos, drawings, and other graphical materials.	3.70	.475	Strongly Agree
makes me feel confident (proud) that I can create visual outputs like infographics, photos, drawings, and other graphical materials related to the topics discussed in the STS course.	3.73	.471	Strongly Agree
I am confident that the visual outputs I create in the STS course are reflections of what I understood about the lesson.	3.69	.489	Strongly Agree
By doing creative activities, I enjoyed learning the STS course.	3.68	.509	Strongly Agree
By doing creative activities in the STS course, learning this course is less boring.	3.73	.509	Strongly Agree
The creative activities I made in the STS course serve as an application of what I learned in the course.	3.70	.486	Strongly Agree
Composite	3.71	.357	Strongly Agree

Scale of Means: 4.00 – 3.26 Strongly Agree; 3.25 – 2.51 Agree; 2.50 – 1.76 Disagree; 1.75
1.00 Strongly Disagree; M-Mean; SD-Standard Deviation; DE-

Descriptive Equivalent

In the table, the highest rating provided by the respondents is "I learn more in the STS course when I make creative activities related to the lesson." (M=3.78; SD=.447; Strongly Agree) followed by "I love to use software (Canva, Word Cloud, Adobe, MS Word, MS Publisher) to showcase my creativity." (M=3.75; SD=.482; Strongly Agree) while the lowest is "I learn more in the STS course when I work with my classmates in small groups." (M=3.66; SD=.556; Strongly Agree).

The composite rating, M=3.71; SD=.357, denotes that the respondents "Strongly Agree" with the indicators on the conduct of activities.

To effectively address the increasing demand for individuals to think and act creatively, educational institutions must integrate creativity-enhancing approaches across the curriculum (Bolden, 2020). This integration is not only important for improving collaboration and teaching-learning outcomes but also integral in refining the skills necessary for thriving in the complexities of the twenty-first century (Haim, 2024). As the technological world rapidly evolves, educational strategies must adapt accordingly to prepare students for future challenges and opportunities

(Mian, 2020).

Incorporating creativity into teaching methodologies involves more than simply adding creative projects to the syllabus. It requires a comprehensive rethinking of pedagogical practices to encourage critical thinking, problem-solving, and innovative thinking (Nykyporets, 2024). For instance, interdisciplinary projects can bridge gaps between subjects, allowing students to draw connections between disparate fields and apply their knowledge in novel ways. This approach will not only supplement their learning experience but also mirror the interconnected nature of modern-day challenges.

Moreover, nurturing a classroom environment that values curiosity and experimentation is imperative, thus university educators should provide opportunities for students to explore and experiment without fear of failure (Cavicchi, 2024). This can be achieved through project-based learning, where students work on real-world problems and develop solutions collaboratively (Santana, 2024). By engaging in such projects, students can learn to approach problems creatively by considering multiple perspectives and solutions.

Additionally, the integration of technology in the classroom can significantly enhance creative thinking. Digital tools and resources offer new avenues for students to express their ideas and collaborate with peers (Haleem, 2022). For example, using simulation software or virtual reality can provide immersive learning experiences that stimulate students' imaginations and encourage creative problem-solving (Araiza-Alba, 2021).

Assessment methods should also be reconsidered to support creativity (Ehtıyar, 2019). Traditional testing often emphasizes rote memorization and standardized responses, which can stifle creative thought. Instead, formative assessments, peer reviews, and self-assessments can provide more comprehensive insights into students' creative processes and outcomes (Wylie, 2019). These methods allow students to reflect on their learning and understand the value of creativity in their work.

Furthermore, professional development for educators is important in promoting a creative learning environment (Suyuti, 2024). Teachers must be equipped with the skills and knowledge to implement creative approaches effectively (Minh, 2024). This includes training in new pedagogical strategies, technology integration, and methods for nurturing a growth mindset in students (Hamzah, 2024).

Therefore, to prepare students for the demands of the twenty-first century, educational institutions must increase creativity-focused approaches across the curriculum. This involves creating interdisciplinary learning opportunities, encouraging experimentation, proper use of technology, and adopting innovative assessment methods. By doing so, educators can improve collaboration and

teaching-learning outcomes which can equip students with the creative skills necessary to thrive in an ever-evolving world.

Table 2 shows the learning experiences of STS students in terms of the learning modality.

Table 2. Learning Modality

Indicators	M	SD	DE
The recorded video lectures make me understand the lesson better.	3.46	.666	Strongly Agree
prefer to watch and listen to a recorded video than synchronous discussions.	3.04	.509	Agree
prefer that my instructor answer my inquiries immediately via FB messenger or email.	3.64	.585	Strongly Agree
I prefer that my instructor communicates with me whenever I have difficulties in learning STS.	3.72	.519	Strongly Agree
5. I am intimidated to speak or answer my instructor's questions in synchronous classes.	2.98	.480	Agree
I prefer that my instructor provide a detail detailed schedule to guide me in learning STS.	3.68	.537	Strongly Agree
prefer that my instructor follow the scheduled activities to help me learn STS.	3.73	.464	Strongly Agree
8. I prefer that enough time (2-4 days) is given prior to the submission of each activity.	3.75	.480	Strongly Agree
I prefer that my instructor adjust (i.e. submission of activities, quizzes, major exams) whenever unexpected events happen.	3.78	.412	Strongly Agree
I prefer that my instructor provides feedback whenever I take quizzes and activities.	3.77	.443	Strongly Agree
Composite	3.55	.366	Strongly Agree

Scale of Means: 4.00 – 3.26 Strongly Agree; 3.25 – 2.51 Agree; 2.50 – 1.76 Disagree; 1.75
1.00 Strongly Disagree; M-Mean; SD-Standard Deviation; DE-

Descriptive Equivalent

As shown, the indicators "I prefer that my instructor adjust (i.e. submission of activities, quizzes, major exams) whenever unexpected events happen." posted the highest rating (M=3.78; SD=.412, Strongly Agree), and "I prefer that my instructor provides feedback whenever I take quizzes and activities." (M=3.77; SD=.443, Strongly Agree) as the second highest while the lowest rating was on "I am intimidated to speak or answer my instructor's questions in synchronous classes." (M=2.98; SD=.873, Agree).

Overall, the respondents "Strongly Agree" with the statements on the

experiences in terms of learning mode as indicated by the rating (M=3.55; SD=.366). Student involvement is an indispensable component of the learning and teaching process, one that faces significant challenges in the transition to online classes (García- Morales, 2021). This involvement includes not only the students' academic engagement but also their sense of attachment to the school environment, its support systems, and their complete educational experience (Bowden, 2021). Regardless of the modality of learning—be it face-to-face, hybrid, or entirely online—the depth of students' involvement in their education is profoundly influenced by their sense of connection and belonging to the educational institution and its associated support services (Moldez, 2024).

In traditional in-person settings, students often benefit from direct interactions with peers, faculty, and staff, as well as access to on-campus resources that collectively develop a sense of community and belonging. This environment naturally supports student involvement, providing social and academic experiences that enhance learning outcomes. However, the shift to online learning environments necessitates a reimagining of how such involvement can be maintained and even enhanced (Neuwirth, 2021).

Online learning raises new challenges to student involvement, primarily due to the physical separation between students and their educational institutions (García- Morales, 2021). This separation can lead to feelings of isolation and disconnection, which may adversely affect students' motivation, engagement, and educational experience. To moderate these effects, it is essential to implement strategies that can develop a sense of community and belonging in virtual spaces. One effective strategy is the use of synchronous online activities, such as live lectures, real-time discussions, and virtual office hours, which can help stimulate the immediacy and intimacy of in- person interactions (Uyanne, 2024). These activities can provide opportunities for students to engage actively with their instructors and peers, to advance presence and immediacy that can bridge the physical gap inherent in online learning. Furthermore, asynchronous activities, such as discussion forums, collaborative projects, and multimedia assignments, can improve the learning experiences of the students by maintaining involvement that allows flexible participation and sustained interaction over time.

Support systems are equally important to safeguard student involvement in online learning contexts. Academic advising, counselling services, and technical support must be readily accessible to students, providing the necessary scaffolding to navigate the online learning environment effectively (Rotar, 2022). These services should be designed to proactively reach out to students while supporting their needs and concerns promptly and comprehensively.

Additionally, tools such as learning management systems (LMS), virtual labs, and gamified learning modules can enhance student involvement by making

learning more dynamic and interactive (Zhao, 2021). These technologies not only facilitate better engagement with the content but also promote collaboration and interaction among students.

Moreover, promoting a culture of inclusivity and support within the online learning community is a primary consideration (Singha, 2024) . Institutions should prioritize creating an environment where all students feel valued and included, regardless of their backgrounds or circumstances (Williams, 2024). This can be achieved through inclusive teaching practices, equitable access to resources, and continuous feedback mechanisms that ensure student voices are heard and addressed.

Thus, student involvement is a significant aspect of the educational process that faces challenges in the context of online learning. Ensuring that students remain engaged and connected to their educational institutions requires deliberate and thoughtful strategies that encourage interaction, support, and a sense of community. By rethinking and enhancing how we engage students online, educational institutions can not only preserve but also potentially improve the educational experience, even in the absence of physical presence.

Table 3 shows the learning experiences of STS students in terms of the relevance of the course to the program.

Table 3. Relevance to the Program

Indicators	M	SD	DE
I am motivated to proceed with the next chapter of the module whenever my instructor gives me feedback.	3.72	.496	Strongly Agree
prefer that STS is taught in the context of my program of specialization (Education, Accountancy, Psychology, Business Management).	3.67	.546	Strongly Agree
prefer that the examples given in the module and video lectures are related to my major.	3.71	.489	Strongly Agree
I prefer that the examples given in the module and video lectures are related to my real-life experiences.	3.71	.482	Strongly Agree
I prefer that the examples given in the module and video lectures are connected with other subjects like Language, Math, Philosophy, History, Accountancy, Education, Business and, others.	3.63	.550	Strongly Agree
I prefer that the concepts in the STS module are applicable to my day-to-day life.	3.69	.506	Strongly Agree

7. I learn topics in STS better when I have previous experience (or knowledge) about the topics being discussed.	3.70	.468	Strongly Agree
I appreciate STS discussions when I can relate my personal experience to the topics.	3.74	.448	Strongly Agree
I usually watch related videos or search the internet whenever I want to clarify certain topics about the lesson.	3.35	.749	Strongly Agree
10. I can find all the answers to my personal questions online about the topics in STS.	3.05	.842	Agree
Composite	3.60	.345	Strongly Agree

Scale of Means: 4.00 – 3.26 Strongly Agree; 3.25 – 2.51 Agree; 2.50 – 1.76 Disagree; 1.75
– 1.00 Strongly Disagree; M-Mean; SD-Standard Deviation; DE-Descriptive Equivalent

Based on the table, the indicator "I appreciate STS discussions when I can relate my personal experience to the topics." obtained the highest rating (M=3.74; SD=.448, Strongly Agree) followed by "I am motivated to proceed with the next chapter of the module whenever my instructor gives me feedback." (M=3.72; SD=.496, Strongly Agree) as the second highest while the lowest rating was on "I can find all the answers to my personal questions online about the topics in STS." (M=3.05; SD=.842, Agree). In general, the rating (M=3.60; SD=.345) implies that the respondents "Strongly Agree" with the indicators listed on the experiences in terms of the relevance of the program.

Students show a clear preference for teaching Science, Technology, and Society (STS) in a manner that incorporates detailed instruction and examples closely related to their specific fields of study, such as Education, Accountancy, Psychology, and Business Management. They value when the instructional content includes practical examples and contextual information pertinent to their major, as this approach helps them better understand and engage with the material (Berisha, 2024). By connecting STS topics to their academic disciplines, students find the content more relevant and easier to grasp.

Moreover, students prefer that examples provided in modules and video lectures are drawn from real-life experiences that apply to their daily lives. This preference noted the importance of using practical, relatable examples that students can connect with on a personal level. When educational materials reflect real-world scenarios, they become more meaningful and applicable, thereby enhancing student engagement and comprehension (Marley, 2022).

For instance, an accountancy student may benefit from case studies involving advancements in financial technology, while a psychology student might

find relevance in discussions about societal influences on mental health. By integrating such examples into the curriculum, university educators can bridge the gap between theoretical concepts and practical applications, making the learning experience more engaging and applicable to students' professional and personal contexts.

Hence, providing detailed, discipline-specific instruction and incorporating real- life applications into STS teaching can improve the learning experiences of university students. When educational content aligns with students' majors and reflects real- world scenarios, it supports better understanding and connection to the material, thereby making STS education more relevant and impactful.

Table 4 shows the learning experiences of STS students in terms of the module Content and graphics.

Table 4. Module Content and Graphics

Indicators	M	SD	DE
The module has enough information I need to learn the topics in STS.	3.40	.570	Strongly Agree
Some parts of the module contain too much information that I cannot process by myself.	3.02	.756	Agree
3. Some parts of the module are difficult to understand so I have to ask my instructor about it.	2.85	.807	Strongly Agree
Some parts of the module are not related to my program of specialization so I do not read it thoroughly.	2.48	.941	Disagree
Some parts of the module are boring and difficult to understand.	2.43	.921	Disagree
I prefer that the module has more graphics and pictures than text.	3.37	.717	Strongly Agree
I prefer reading the printed copy rather than the digital copy of the module.	3.49	.717	Strongly Agree
I prefer to read the summary (PowerPoint slides) than the learning module.	3.35	.759	Strongly Agree
9. I prefer that the video lectures have related graphics and photos that will help me understand the lesson in STS better.	3.65	.488	Strongly Agree
I prefer to read more graphical learning material than the textual module.	3.43	.658	Strongly Agree
Composite	3.16	.418	Agree

Scale of Means: 4.00 – 3.26 Strongly Agree; 3.25 – 2.51 Agree; 2.50 – 1.76 Disagree; 1.75
– 1.00 Strongly Disagree; M-Mean; SD-Standard Deviation; DE-Descriptive Equivalent

As reflected, the highest rating provided by the respondents is "I prefer that the video lectures have related graphics and photos that will help me understand the lesson in STS better." (M=3.65; SD=.488; Strongly Agree) while low ratings were found on "Some parts of the module are not related to my program of specialization so I do not read it thoroughly." (M=2.48; SD=.941; Disagree).and "Some parts of the module are boring and difficult to understand." (M=2.43; SD=.921; Disagree).

As a whole, the rating, M=3.16; SD=.418, signifies that the respondents "Strongly Agree" with the indicators on the module graphics.

The result of this study revealed that infographics and positive self-assessment of enjoyment and pleasure are significantly correlated, suggesting that infographics enhance the learning experience. Additionally, students who engaged with infographics retained their new knowledge more effectively over time compared to those who only utilized pictures and text (Jaleniauskiene, 2023). This indicates that infographics may offer a more robust support for learning by facilitating deeper and more lasting retention of information.

The concept of visual literacy, which incorporates the ability to interpret and derive meaning from images and symbols, underpins the effectiveness of infographics (Crome, 2023). Visual literacy allows for more immediate communication of meaning through images than through traditional print, thus making it a potent tool for teaching. This skill is increasingly recognized as essential for twenty-first-century professionals, who must try to explore and interpret a wide range of visual information.

The research further demonstrated that infographics (information visuals) can aid in engaging students within the domain of science. They not only motivate students to undertake research for class projects but also enhance their ability to communicate their findings effectively to peers. This use of infographics as a pedagogical tool offers a means to integrate visual representation into the teaching of subjects that often involve complex numerical data, thereby making the online teaching material more accessible and engaging (Pérez, 2023).

In practical terms, the study illustrated how university educators might employ infographics created by students and/or teachers to better support online instruction. By incorporating these visual tools, teachers can transform typically dry and abstract content into more engaging and comprehensible material, henceforth developing a more dynamic and interactive learning environment.

CONCLUSION

To address the growing emphasis on creative thinking in the twenty-first century, educational institutions must integrate creativity throughout their curricula

in a fundamental way, particularly in an online teaching setup. This approach extends beyond simply adding creative projects; it involves a comprehensive re-evaluation of teaching practices to develop critical thinking, problem-solving, and innovation. By applying interdisciplinary projects, university instructors can bridge subject areas and mirror the interconnected nature of real-world issues which can lead to enriching students' learning experiences. An online environment that encourages curiosity and experimentation such as project-based learning also helps students approach challenges creatively. Also, using technology such as simulation software and virtual reality can stimulate imaginative thinking. Evolving assessment methods that focus on formative assessments and peer reviews, rather than rote memorization, further support creativity. In addition, professional development for university educators in online teaching is also vital to equip them with the necessary skills to implement these strategies effectively.

Student involvement is a very important aspect of the teaching-learning process but faces huge challenges in online learning environments. In traditional face- to-face settings, students benefit from direct interactions and accessible resources that promote a sense of community and belonging while their physical separation in online learning can lead to isolation and impact motivation and engagement. To counter these challenges, university instructors must explore strategies that can simulate in-person interactions, such as synchronous online activities and asynchronous collaborative projects, this can provide robust support systems, and create an inclusive online environment that can help maintain and even enhance student involvement, hence enriching the learning experience despite the absence of physical presence.

Students show a strong preference for Science, Technology, and Society (STS) instruction that includes detailed, discipline-specific examples related to their fields of study, such as Education, Accountancy, Psychology, and Business Management. This preference summarizes the value of connecting educational content to students' academic and professional contexts. Through the incorporation of real-life examples and practical applications, educators can bridge the gap between theoretical concepts and tangible experiences, possibly increasing both comprehension and engagement. Thus, aligning STS education with students' major disciplines will not only make the material more relevant but can also enrich their educational experience.

The study also reveals that infographics significantly enhance the learning experience by improving student engagement and knowledge retention. The use of infographics led to students' enjoyment suggesting that these visual tools support deeper, more lasting learning compared to traditional methods. Infographics utilize visual literacy to convey complex information effectively, a skill that is increasingly important in today's image-rich environment. By integrating infographics into

teaching, particularly for subjects involving complex data, university educators can transform abstract content into engaging and interactive learning experiences that not only benefit students' comprehension but also augment the teaching-learning outcomes.

Based on the research findings, it is recommended that higher education institutions adopt a holistic approach to integrating creativity within the curricula, particularly for courses being offered with online components. This approach should involve a thorough rethinking of teaching practices to develop critical thinking, problem-solving, and innovation. Additionally, creating a classroom environment that encourages curiosity and experimentation through project-based learning, alongside enhanced use of technology such as simulation software and virtual reality, can boost students' imaginative and problem-solving skills. Evolving assessment methods to include formative assessments and peer reviews rather than relying solely on rote memorization will also support the development of creativity. Furthermore, investing in professional development for university educators to equip them with the skills necessary to implement these creative strategies is essential for successful integration.

To address the challenges posed by online learning environments, higher education institutions should implement strategies to maintain and enhance student involvement despite the physical separation. This includes incorporating synchronous online activities like live lectures and discussions, as well as asynchronous collaborative projects to promote a sense of community and engagement. Providing robust support systems, including academic advising, counseling services, and technical support, is also a great help for students to endure the online learning world. Additionally, adapting Science, Technology, and Society (STS) education to include detailed, field- specific examples and real-life applications can make the content more relevant and engaging for students. Lastly, the use of infographics to present complex data effectively can further improve comprehension and retention, transforming abstract material into interactive and meaningful learning experiences.

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