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Feasibility and Effectiveness of Online Learning for Engineering Students at Marshall University in the Post-Pandemic Era

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Feasibility and Effectiveness of Online Learning for Engineering Students at Marshall University in the Post-Pandemic Era

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Abstract

Since the outbreak of the COVID-19 pandemic, asynchronous online learning has become a prominent method of education, yet its impact on student satisfaction remains inconclusive. This study investigates the experiences of 228 students via a comprehensive online survey at Marshall University with asynchronous learning platforms, assessing their effectiveness in fostering engagement and achievement. This study employs a quantitative research approach to gain insights into the usefulness of these platforms. Data was gathered using Marshall's Qualtrics TOS survey tool. The analysis involved SPSS to identify trends and correlations specifically from student perspectives, as this study focuses solely on their experiences. The findings reveal that while 45% of students reported positive experiences, significant issues persist: 53% experienced stress, 44% encountered technical difficulties, and 86% did not participate in external support programs. Confidence in digital tools was relatively high, with 49% feeling very confident. These results highlight the need for more interactive and adaptive content, robust technical support, and stronger feedback mechanisms to enhance learning outcomes. This study provides actionable recommendations for integrating these improvements into engineering and other higher education curricula, bridging the gap between technology and pedagogy to meet student needs effectively in a post-pandemic academic environment.

Introduction

Before the COVID-19 pandemic accelerated the adoption of online learning platforms, existing research had already explored student preferences and challenges related to online education [1-4]. Both synchronous and asynchronous modes were gaining traction, with synchronous learning enabling real-time interaction and feedback, while asynchronous formats offered greater flexibility [3]. The pandemic forced a swift global transition to online education, prompting institutions to employ synchronous and asynchronous teaching approaches [5, 6]. As mentioned earlier, asynchronous learning rose in prominence during this period, encouraging researchers to focus on

best practices for its implementation [5]. This shift mirrored a steady growth in online education within U.S. postsecondary institutions, which saw an annual growth rate of 7% [7].

The global pandemic also spurred significant cultural changes, accelerating the integration of online platforms. Studies conducted during this time underscored the advantages of online learning, including flexibility and convenience, leading to positive outcomes in student evaluations and academic performance across disciplines [2, 4, 8-10]. However, challenges persisted, such as students' preference for face-to-face interaction, technical issues like poor internet connectivity, and increased psychological stress, including anxiety and fatigue, which negatively impacted their online learning experiences [8, 11-14]. The sudden transition posed difficulties for both students and instructors, who had to adapt rapidly to new digital tools and teaching methods [5].

Asynchronous online learning has gained sustained popularity in the post-COVID era due to its accessibility and flexibility. Building on prior research, learning outcomes in asynchronous courses can be comparable to those in traditional settings, provided that course content, learning outcomes, and student motivation are well-aligned [4]. Combining synchronous and asynchronous approaches has been shown to enhance course outcomes and student performance, although the choice of format should account for course-specific content and student needs [6].

At Marshall University, asynchronous learning programs have been developed to provide students with greater flexibility, recognizing the long-term importance of virtual learning. As online education continues beyond the pandemic, institutions need to strengthen their capabilities—ranging from policy development to instructional and learner support—to ensure the quality of online education remains high [14]. Researchers have created guidelines for designing effective asynchronous courses and delivering appropriate feedback, to cultivate expert instructors across educational settings [5]. This research assesses the feasibility and effectiveness of asynchronous learning, with a focus on improving student success and satisfaction at Marshall University. Moving forward, it is vital to maintain asynchronous learning as an attractive and viable option for students in a rapidly evolving educational landscape.

This paper proceeds as follows: Section 1 presents the introduction. Section 2 presents the literature review. Sections 3 and 4 outline the study questions and hypotheses. Section 5 explains the methodology and the process. Section 6 presents the results and discussion. Section 7 outlines the suggestions for improvements. The conclusion is stated in Section 8.

Related Works

In early 2020, the COVID-19 pandemic emerged, triggering widespread changes in organizational practices and cultural norms worldwide. Educational institutions and universities were able to experience a considerable impact [15, 16]. These educational institutions are required to

implement online distance learning (ODL) systems to maintain their instructional operations while simultaneously adjusting to the new criteria. Due to the pandemic, there was a rapid shift toward online education, particularly asynchronous learning, which involves interactions and classes that do not take place in real time. These days, this is an essential part of the teaching tactics that are used [17, 18]. The researchers investigated how well-prepared teachers and students were to use modern information and communication technologies (ICTs) to maintain instructional continuity while adhering to social distancing criteria [19]. This shift demonstrated the necessity of adaptive educational tools and methods.

Asynchronous learning technologies offer flexibility in terms of accessing course materials and turning in homework [20]. Due to the limitations imposed by the epidemic, these technologies are becoming increasingly popular. Nevertheless, there have been many difficulties connected with this change from the start. To have a comprehensive educational experience, it is required to overcome challenges such as a limited internet connection, a lack of interpersonal interaction, and unfamiliarity with digital platforms [17, 18, 21]. These challenges have been met by both teachers and students. Concerns have also been expressed regarding the mental health of students and their capacity to retain academic focus because of their lack of connection with traditional classroom situations [22]. These factors underscore the need for enhanced resources and tailored mental health support to improve the overall educational experience.

The rapid development of e-learning has been significantly aided by information and communication technologies (ICTs) [23], but the widespread adoption of these technologies has also led to issues that may hurt the educational experiences of students. There are both positive and negative aspects associated with the utilization of asynchronous learning strategies. The use of technology has, on the one hand, made it possible for students to manage their schedules more effectively and to continue their education even in the case that they are unable to attend classes in person [21]. On the other hand, the absence of fast communication has resulted in a reduction in the spontaneous knowledge-sharing and collaboration that occurs between students and teachers. This may lead to feelings of alienation and detachment from the learning community [22, 24]. It has a considerable impact on the effectiveness of the learning process as well as the level of participation it receives from students. Because unequal access to stable internet and appropriate devices hindered equitable learning opportunities, the digital gap was also brought to light by the sudden and broad adoption of these technologies [18].

In addition to providing students with the necessary technological resources, educational institutions are required to ensure that teachers are adequately trained to provide productive online learning environments. This is because the trend toward asynchronous and other online learning approaches has brought attention to the necessity of educational institutions to ensure that teachers are adequately trained. To accomplish this, it is necessary to raise awareness among educators on digital pedagogies and to ensure that they have the necessary assistance to successfully manage their virtual classrooms [17, 18]. The first detection of COVID-19 cases and the subsequent

transmission of the virus were the circumstances that led to these unusual learning challenges [25, 26]. These circumstances were brought about by the spreading of the virus. In the course of the infection's spread, statistics from reputable sources such as Johns Hopkins University brought to light the severity of the situation, which in turn prompted additional educational activities [27]. The explanation that Doshi provides for the concept of a pandemic emphasizes the importance of taking global action considering these circumstances [28].

Research Questions

This quantitative study is aiming to answer the following questions:

RQ1: To what extent does the online learning environment impact students' academic performance, stress levels, and digital literacy?

RQ2: To what extent does external support impact motivation programs and access to digital equipment, on students' online learning experiences and outcomes?

RQ3: To what extent can students' ability to quantitatively manage stress and adapt to the online learning environment be linked to their overall satisfaction and independence as learners?

Research Hypothesis

H1: The online learning environment significantly affects students' academic performance, with higher levels of stress associated with lower performance.

H2: External support factors significantly influence students' online learning experiences, leading to reduced stress levels and greater participation in online discussions.

H3: Students who effectively manage stress and adapt to the online learning environment will report higher satisfaction levels and greater independence as learners.

Research Methodology

Data Collection and Participant Inclusion Criteria

This research acquired and analyzed data using a quantitative methodology. To capture the data, a convenient online questionnaire, namely Marshall Qualtrics TOS, was used per the University's regulations. The questionnaire was divided into three major sections: demographic information, quantitative questions intended to generate descriptive analysis, and closed-ended questions designed to assess the impact of online learning. Purposive sampling was utilized to gather data, with an initial sample of Marshall University students who had prior exposure to online learning selected. To collect data, requests and reminders were sent via Marshall's official email address.

The research aimed to collect 228 responses, deemed adequate for producing meaningful descriptive analyses while preserving the relevance of the data [29].

Data Analysis Process

A quantitative approach was employed to analyze the survey data. The study's purpose was to identify common obstacles and sources of tension that students encountered. Extensive quantitative analysis was conducted to identify patterns, trends, and correlations within the data.

Result and Discussion

Participant's Demographic Information

The demographic data of the study participants at Marshall University presents a comprehensive and diverse representation of the student body engaged in asynchronous online learning, as illustrated in **Table 1**.

Table 1: Participant Demographic Information

Demographic Category	Number of Participants	Percentage
Total Participants	228	100%
Gender		
Male	120	53%
Female	97	43%
Other	4	2%
Prefer not to say	7	3%
Age Group		
18-20	87	38%
21-23	68	28%
24-27	16	7%
28-Older	62	27%
Academic Pursuit		
Bachelor's degree	161	71%
Master's degree	49	21%
Doctorate	18	8%

The gender distribution includes 120 males (53%), 97 females (43%), 4 individuals identifying as other (2%), and 7 participants who chose not to disclose their gender (3%) as shown in **Figure 1**. This balanced gender ratio ensures adequate representation, enabling a comprehensive analysis of potential gender-related differences in academic performance within the asynchronous online learning setting.

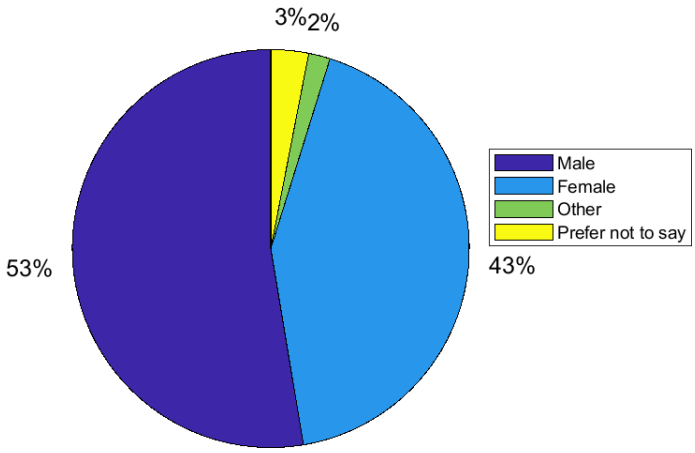

Figure 1. Gender Distribution

In terms of age distribution, the majority of participants are students aged 18-20, comprising 87 individuals (38%). This is followed by 68 students aged 21-23 (28%), 16 students aged 24-27 (7%), and 62 students aged 28 and above (27%), as illustrated in **Figure 2**. This age distribution offers a valuable insight into the student population, facilitating a detailed analysis of how various age groups engage with asynchronous online learning at Marshall University.

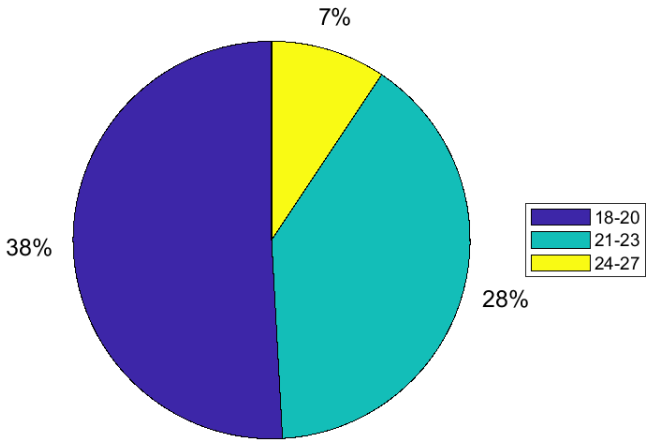

Figure 2: Age Group Distribution

Academically, most participants are pursuing a bachelor's degree, with 161 students (71%) in this category as presented in **Figure 3**. Additionally, 49 participants (21%) are working towards a master's degree, and 18 students (8%) are aiming for a doctorate. The inclusion of a diverse range of academic pursuits among the participants enhances the study's ability to comprehensively assess student perceptions of asynchronous online learning, providing valuable insights that can inform future educational strategies and practices at Marshall University

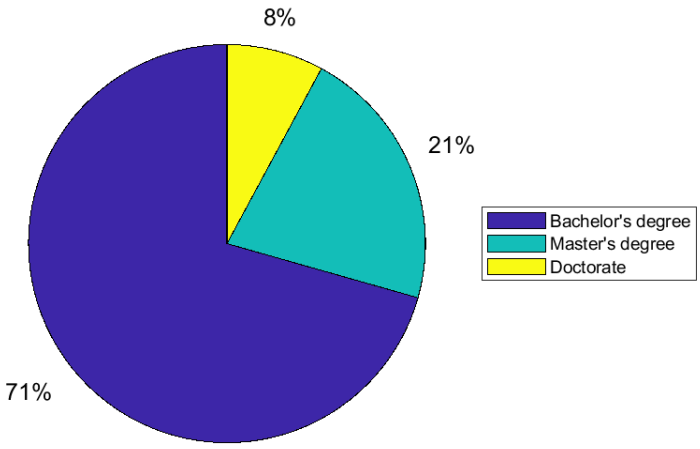

Figure 3: Academic Pursuit Distribution

Student Participations

The survey focuses on understanding various aspects of asynchronous online learning from the perspective of students. It aims to gather insights on their overall experience and satisfaction, technical challenges, engagement levels, support received, and the impact on their independence and confidence in using digital tools as shown in Tables 2-6.

Overall Experience and Satisfaction

A survey of 224 participants revealed a variety of opinions on online learning experiences. A significant portion, 45%, had favorable experiences, with 17% reporting very positive experiences as presented in **Table 2**. However, 15% shared negative experiences, and 24% remained neutral. Among 212 respondents, 40% were satisfied, 17% were delighted, 14% expressed dissatisfaction, and 29% were neutral. Overall, 39% were satisfied with their learning journey, 19% were very satisfied, 13% were dissatisfied, and 29% were neutral. These results indicate a generally positive trend, though some areas still need improvement.

Table 2: Experience and Satisfaction

Category	Number of Participants	Percentage
Overall Experience with Online Learning (224 Total)		
Very Negative	5	2%
Negative	29	13%
Neutral	53	24%
Positive	100	45%
Very Positive	37	17%
Overall Satisfaction with Online Learning (212 Total)		
Very Dissatisfied	11	5%
Dissatisfied	19	9%
Neutral	62	29%
Satisfied	84	40%

Very Satisfied	36	17%
Overall Satisfaction with Online Learning Experience (212 Total)		
Very Dissatisfied	8	4%
Dissatisfied	19	9%
Neutral	61	29%
Satisfied	83	39%
Very Satisfied	41	19%

Technical and Resource Support

A survey of 224 participants assessed confidence in using digital tools for learning, revealing that 49% felt very confident and 18% extremely confident, while 28% were somewhat confident as shown in **Table 3**. A small percentage, 5%, were not very confident, and less than 1% were not confident at all. Among 212 respondents, 56% reported no issues accessing materials, but 44% faced technical difficulties. Satisfaction with online resources showed that 53% were satisfied, 12% very satisfied, 25% were neutral, and 9% were dissatisfied, with only 1% very dissatisfied. Regarding online support services, 35% were satisfied, 10% very satisfied, 41% were neutral, 9% dissatisfied, and 4% very dissatisfied. These results highlight both strengths and areas for improvement in technical support and resources.

Engagement and Interaction

A survey of 212 participants evaluated engagement with online lectures and presentations, revealing that 32% found them engaging 7% found them very engaging, and 31% were neutral as

Table 3: Technical and Resource Support

Category	Number of Participants	Percentage
Confidence in Using Digital Tools for Learning (224 Total)		
Not at all confident	1	0.44%
Not very confident	11	5%
Somewhat confident	63	28%
Very confident	109	49%
Extremely confident	40	18%
Technical Issues/Difficulties Accessing Materials (212 Total)		
No	119	56%
Yes	93	44%
Satisfaction with Online Resources (212 Total)		
Very Dissatisfied	3	1%
Dissatisfied	17	8%
Neutral	54	25%
Satisfied	112	53%
Very Satisfied	26	12%
Satisfaction with Online Support Services (212 Total)		
Very Dissatisfied	8	4%
Dissatisfied	20	9%
Neutral	87	41%

Satisfied	75	35%
Very Satisfied	22	10%

illustrated in **Table 4**. However, 25% did not find them engaging, and 6% felt they were not conducive to learning. Regarding satisfaction with interaction and communication, 37% were satisfied, and 10% were very satisfied, whereas 33% remained neutral. Dissatisfaction was reported by 16%, with 5% very dissatisfied. Participation in motivation programs and support was low, with only 14% participating, while 86% did not. These results underscore varying levels of engagement and satisfaction, highlighting areas needing attention for improvement in interaction and support.

Table 4: Engagement and Interaction

Category	Number of Participants	Percentage
Engagement with Online Lectures/Presentations (212 Total)		
Not Conducive to Learning	12	6%
Not Engaging	54	25%
Neutral	65	31%
Engaging	67	32%
Very Engaging	14	7%
Satisfaction with Interaction/Communication (212 Total)		
Very Dissatisfied	10	5%
Dissatisfied	33	16%
Neutral	70	33%
Satisfied	78	37%
Very Satisfied	21	10%
Participation in Motivation Programs/Support (212 Total)		
No	182	86%
Yes	30	14%

Support and Feedback

A survey of 212 participants assessed the effectiveness of external support received during online learning, with 8% finding it effective and 3% highly effective as detailed in **Table 5**. However, a significant majority, 78%, remained neutral, while 7% found the support not effective and 3% considered it slightly effective. Regarding feedback on assessments, 73% of respondents reported receiving timely and constructive feedback, whereas 27% did not. These results suggest that while a substantial portion of participants receive timely feedback, the effectiveness of external support could be improved.

Table 5: Support and Feedback

Category	Number of Participants	Percentage
Effectiveness of External Support Received (212 Total)		
Not Effective	15	7%
Slightly Effective	7	3%

Neutral	166	78%
Effective	17	8%
Highly Effective	7	3%
Timely/Constructive Feedback on Assessments (212 Total)		
No	57	27%
Yes	155	73%

Learning Autonomy and Confidence

A survey of 212 participants explored learning autonomy and confidence, revealing that 45% felt very independent, 19% felt extremely independent, and 27% were neutral as depicted in **Table 6**. A small portion felt less autonomous, with 7% not very independent and 2% not independent at all. Regarding the flexibility of online learning, 35% found it helpful 34% found it extremely helpful, while 21% remained neutral. Only 8% found it not helpful, and 1% found it not helpful at all. Additionally, among 224 respondents, 53% sometimes experienced stress related to online learning, 25% often felt stressed, 17% rarely felt stressed, and 5% always felt stressed. These results highlight a generally positive perception of learning autonomy and the flexibility of online learning, though stress levels vary.

Table 6: Learning Autonomy and Confidence

Category	Number of Participants	Percentage
Independence in Learning (212 Total)		
Not at all Independent	4	2%
Not very independent	15	7%
Neutral	58	27%
Very Independent	95	45%
Extremely Independent	40	19%
Helpfulness of Online Learning Flexibility (212 Total)		
Not at all Helpful	3	1%
Not Helpful	17	8%
Neutral	45	21%
Helpful	74	35%
Extremely Helpful	73	34%
Frequency of Stress Related to Online Learning (224 Total)		
Rarely	39	17%
Sometimes	118	53%
Often	56	25%
Always	11	5%

Feedback and Improvements

Overall Satisfaction and Stress Levels

Students at Marshall University have shared their experiences with asynchronous online learning, highlighting both positive aspects and areas needing attention. A significant portion (45%) reported a positive experience, with 17% rating it very positive. However, 24% remained neutral,

and 15% had negative experiences. This indicates that while many students appreciate asynchronous learning, there are areas where improvements could enhance satisfaction.

Stress related to online learning is a common issue. More than half of the students (53%) sometimes felt stressed, and 25% often experienced stress. Only 17% rarely felt stressed, while 5% always felt stressed. These findings suggest a need for better stress management and support systems to help students handle the demands of online learning more effectively.

Confidence in Digital Tools and External Support

Confidence in using digital tools is generally high among students. Nearly half (49%) felt very confident, and 18% were extremely confident in their digital skills. However, 28% were somewhat confident, and 5% were not very confident. Providing additional training and resources could help those who feel less assured.

Participation in external support programs was low, with 86% of students not engaging in such programs. Among those who did, the majority found the support to be neutral (78%) in effectiveness. Only 8% found it effective, and 3% found it highly effective. This suggests that these programs need to be more engaging and tailored to meet student's specific needs.

Feedback and Communication

Timely and constructive feedback on online assessments was received by most students (73%). However, 27% did not receive such feedback, highlighting the need for consistency in this area. Ensuring all students get useful feedback is crucial for their academic growth and satisfaction.

Interaction and communication with instructors and classmates received mixed reviews. While 37% were satisfied 10% were very satisfied, 33% were neutral, and 21% were dissatisfied. Improving the quality and frequency of interactions could enhance the learning experience and foster a better sense of community.

Engagement and Technical Issues

Engagement with online lectures and presentations varied. While 32% found them engaging and 7% very engaging, 31% were neutral, and 31% did not find them engaging. Improving the delivery and content of online lectures can make them more interactive and engaging for students.

Technical issues were a concern for 44% of students, who reported difficulties accessing online materials. However, 56% did not face such issues, indicating that while the technical infrastructure is generally reliable, there is room for improvement to ensure smooth access for all students.

Satisfaction with Resources and Support Services

Satisfaction with online resources like videos, readings, and discussion forums was generally high, with 53% satisfied and 12% very satisfied. However, 25% were neutral, and 9% were dissatisfied. This suggests that while most students are content with the resources, continuous enhancement and updating are essential.

The flexibility of online learning was highly valued by students. 34% found it extremely helpful, and 35% considered it helpful in balancing academic and personal responsibilities. However, 21%

were neutral, and a small number found it unhelpful. Maintaining and expanding flexible learning options is important.

Recommendations for Improvement

Engagement with support programs among students is a critical factor in improving academic success and providing overall satisfaction. Nevertheless, inadequate awareness, a lack of perceived relevance to students' immediate requirements, and a misaligned program design are frequently the causes of limited program participation. A structured approach is necessary to address these challenges in order to enhance engagement and effectiveness.

Main Areas for Improvement:

- Awareness and Accessibility: The existence and purpose of available support programs may be unknown to a significant number of students. Inadequate communication strategies frequently contribute to this ignorance. The development of targeted outreach initiatives to broaden awareness and accessibility can be facilitated by conducting semi-structured interviews and focus groups to identify voids in students' understanding.
- Motivational Factors: It is essential to comprehend the reasons for students' reluctance to participate in support programs. Time constraints, skepticism regarding the advantages, or a predilection for alternative forms of assistance are among the most prevalent obstacles. Using qualitative methods to uncover these concerns can provide valuable insights into the ways in which programs can be adjusted to accommodate the preferences and schedules of students.
- Stress Management: Students may experience an overwhelming amount of stress as a result of the consistent deadlines, assignments, and exams that are a common feature of online learning. A supportive and balanced environment can be established by implementing stress management initiatives, including surveys, virtual fitness classes, and relaxation activities.
- Personalized Support Programs: To effectively address the unique requirements of students, motivation and support programs must be both engaging and customized. Comprehensive support for academic and personal development can be achieved through peer mentoring programs, interactive seminars on time management and study skills, regular check-ins with academic advisors, and access to mental health resources.
- Consistent Feedback: Students' success is contingent upon the provision of timely, constructive feedback. Virtual office hours, automated feedback tools for exams, detailed rubrics for clarity, and regular feedback sessions on assignments can guarantee that students receive the necessary support to enhance their performance.
- Interactive Learning: Engagement is contingent upon the establishment of connections between students, instructors, and peers. Fostering a sense of community can be achieved by hosting live Q&A sessions, utilizing discussion forums, and integrating group projects and collaborative assignments.
- Engaging Content Delivery: The incorporation of surveys, questionnaires, discussion prompts, videos, webinars, and infographics can improve the quality of online lectures. Comprehension and interest can be enhanced by dividing lectures into brief segments and correlating concepts to real-world scenarios.

- Updated Resources: The learning experience is improved by maintaining a diverse and current selection of course materials. Ensuring that resources are accessible across devices and that they are updated with the most recent research, trends, and case studies can accommodate a variety of learning styles. Regular student feedback is instrumental in the identification of areas that require refinement and the provision of supplementary materials to enhance comprehension.

By addressing these areas, Marshall University can develop more effective and engaging support programs that resonate with students by addressing these areas. A comprehensive framework for improving the online learning experience can be established by incorporating updated resources, tailored support programs, and a concentration on accessibility and interaction. These enhancements will ensure that institutional support is in accordance with the changing requirements of the student body, thereby ensuring long-term academic success and meaningful engagement.

Conclusions

This study highlights both the benefits and challenges of asynchronous online learning at Marshall University in the post-pandemic era. While students appreciate the flexibility and convenience that online platforms provide, there are still some important areas that need improvement. Offering better support for stress management, more external resources, and more consistent feedback can significantly enhance student satisfaction. To make the experience even better, it's also important to focus on making the content more engaging, building stronger interactions between students and instructors, and improving the technical infrastructure. By addressing these key points, Marshall University can ensure that asynchronous online learning continues to be a meaningful and supportive option for its students.

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