

## IMPACT AND ROLE OF E-LEARNING IN ENHANCING EDUCATIONAL ATTITUDE AND ACADEMIC ACHIEVEMENT FOR SUSTAINABLE DEVELOPMENT OF SECONDARY STUDENTS IN UTTARAKHAND

Dr. Anju Sharma

Assistant professor, Department of Education, Maa Shakambari University

Email: [anjusharma.sre@gmail.com](mailto:anjusharma.sre@gmail.com)

**ABSTRACT:** The rapid advancement of digital technologies has significantly transformed the educational landscape, particularly through the adoption of e-learning platforms. In the context of Uttarakhand, where geographical challenges often limit access to quality education, e-learning has emerged as an effective tool to bridge educational gaps. The present study investigates the impact of e-learning on the academic achievement and educational attitude of secondary level students, while also examining its role in promoting sustainable development. The study adopts a descriptive and analytical research design, focusing on a representative sample of secondary school students from different regions of Uttarakhand. Data is collected using standardized questionnaires and academic performance records. The findings indicate that e-learning positively influences students' academic achievement by providing flexible, accessible, and interactive learning environments. Moreover, it fosters a positive educational attitude by enhancing student engagement, motivation, and self-directed learning. The study further highlights that the integration of e-learning with science and technology contributes to sustainable development by promoting digital literacy, reducing dependency on physical resources, and ensuring inclusive and equitable quality education. The research concludes that effective implementation of e-learning strategies can play a vital role in strengthening the educational system in Uttarakhand and supporting long-term sustainable development goals.

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**Keywords:** E-Learning, Academic Achievement, Educational Attitude, Sustainable Development of Uttarakhand, Secondary Level Students, Digital Education, Technology in Education

### INTRODUCTION

In the 21st century, the rapid advancement of information and communication technologies (ICT) has brought significant changes in the field of education. Traditional teaching-learning methods are gradually being replaced or supplemented by digital learning approaches, making education more accessible, flexible, and learner-centered. The emergence of e-learning has revolutionized the educational system by enabling students to access knowledge beyond the constraints of time and place. In developing regions like Uttarakhand, where geographical barriers often hinder access to quality education, e-learning has emerged as a powerful tool to bridge the educational gap. In the contemporary era, education has undergone a significant transformation due to the rapid advancement of digital technologies. Among these developments, e-learning has emerged as a powerful and flexible mode of education that transcends traditional classroom boundaries. It enables learners to access educational resources anytime and anywhere, thereby

promoting inclusivity and lifelong learning. Particularly in geographically diverse and hilly regions like Uttarakhand, where physical access to quality education is often constrained, e-learning provides an effective solution to bridge the educational divide. Academic achievement and educational attitude are two crucial indicators of students' overall development. Academic achievement reflects the extent to which learners have attained educational objectives, while educational attitude determines their interest, motivation, and engagement in the learning process. The integration of e-learning tools such as online platforms, digital content, and interactive applications has the potential to positively influence both these dimensions by making learning more engaging, personalized, and student-centered. In recent years, the concept of sustainable development has gained considerable importance in the field of education. Sustainable development emphasizes the need for equitable access to quality education, efficient use of resources, and the promotion of skills necessary for future societal needs. E-learning, supported by advances in science and technology, plays a vital role

in achieving these goals by reducing dependency on physical infrastructure, minimizing environmental impact, and promoting digital literacy among students. In the context of Uttarakhand, the adoption of e-learning has gained momentum, especially after the increased reliance on digital education in recent times. However, there is a need to systematically examine how e-learning influences students' academic performance and shapes their educational attitudes, and how it contributes to the broader objective of sustainable development. Therefore, the present study aims to explore the relationship between e-learning, academic achievement, and educational attitude among secondary level students in Uttarakhand, while also analyzing its role in fostering sustainable development. The findings of this study are expected to provide valuable insights for educators, policymakers, and researchers in enhancing the effectiveness of digital education in the region.

### **Concept of E-Learning**

E-learning refers to the use of electronic technologies, particularly the internet, to deliver educational content and facilitate learning. It includes various forms such as online classes, virtual classrooms, digital content, mobile learning, and learning management systems. E-learning promotes self-paced and interactive learning, allowing students to engage with multimedia resources such as videos, simulations, and online assessments. It also supports collaborative learning through discussion forums and virtual communication tools, thereby enhancing the overall learning experience.

### **Importance of Academic Achievement & Educational Attitude**

Academic achievement is one of the most important indicators of students' learning outcomes and reflects their level of knowledge, skills, and competencies acquired through the educational process. It plays a crucial role in determining students' future educational and career opportunities. On the other hand, educational attitude refers to students' interest, motivation, and perception towards learning. A positive educational attitude enhances engagement, persistence, and overall academic performance. Both academic achievement and educational attitude are interrelated and are significantly influenced by the learning environment and teaching methodologies.

### **Role of Technology in Education**

Technology has become an integral part of modern education. It not only facilitates access to information but also enhances the quality of teaching and learning processes. Digital tools such as smart classrooms, educational apps, online platforms, and virtual simulations have made learning more interactive and

engaging. Technology enables personalized learning experiences, allowing students to learn at their own pace and according to their individual needs. Moreover, it supports teachers in delivering content more effectively and assessing students' performance through digital means.

### **Sustainable Development in Education**

Sustainable development in education emphasizes the need for inclusive, equitable, and quality education for all while ensuring the efficient use of resources. It aims to develop knowledge, skills, and values that promote environmental awareness, social responsibility, and economic sustainability. E-learning contributes to sustainable development by reducing the need for physical infrastructure, minimizing the use of paper, and promoting digital literacy. It also ensures continuity of education in challenging situations, thereby supporting long-term educational sustainability.

### **Need for the Study**

Uttarakhand, being a hilly state, faces several challenges in providing quality education, especially in remote and rural areas. Limited access to schools, lack of infrastructure, and shortage of qualified teachers often affect students' academic performance and learning attitude. In recent years, the adoption of e-learning has increased significantly, offering new opportunities to overcome these challenges. However, there is a need to systematically examine the effectiveness of e-learning in improving academic achievement and shaping educational attitudes among secondary-level students in the region. Furthermore, very few studies have focused on the role of e-learning in promoting sustainable development in the context of Uttarakhand. Therefore, the present study aims to fill this gap by analyzing how e-learning influences students' academic outcomes and contributes to sustainable educational practices in the region.

### **LITERATURE REVIEW**

The evolution of e-learning has been widely studied over the past decade, with researchers emphasizing its impact on academic achievement, educational attitude, and its contribution to sustainable development. In the early phase, studies primarily focused on the emergence and effectiveness of online learning. Allen and Seaman (2010) highlighted the rapid growth of online education and its increasing acceptance among learners. Similarly, means et al. (2010) conducted a meta-analysis and found that students in online learning conditions performed modestly better than those receiving traditional face-to-face instruction. Paechter and Maier (2010) emphasized that students' preferences for online or traditional learning environments significantly

influence their academic outcomes. Furthermore, Volery and Lord (2010) identified critical success factors such as technology infrastructure and instructor support in determining the effectiveness of e-learning. In 2011, attention shifted toward learner satisfaction and system acceptance. Liaw and Huang (2011) found that user satisfaction in e-learning environments is influenced by perceived usefulness and interactivity. Likewise, Selim (2011) identified factors such as instructor characteristics, technology readiness, and student attitudes as key determinants of successful e-learning adoption. During the same period, sustainability in education also gained importance, as Tilbury (2011) emphasized the role of education in promoting sustainable development practices. Between 2014 and 2017, research expanded towards blended learning and effectiveness. Bernard et al. (2014) demonstrated through meta-analysis that blended learning environments enhance student achievement compared to traditional methods. Similarly, means et al. (2014) reaffirmed the effectiveness of online learning. Sun et al. (2016) identified learner attitude, instructor quality, and course design as crucial factors influencing e-learning outcomes. Al-Qahtani and Higgins (2016) found that online learning can be equally or more effective than traditional methods under proper conditions. Kintu et al. (2017) further highlighted that student characteristics and instructional design significantly affect learning outcomes, while Martín-Blas and Serrano-Fernández (2017) emphasized the role of technological platforms in improving engagement. The period from 2015 to 2018 also witnessed increasing attention to sustainability and future skills. UNESCO (2015) emphasized the importance of quality education for achieving Sustainable Development Goals (SDGs). Wals (2015) highlighted the integration of sustainability into educational systems, while OECD (2018) stressed the need for digital skills and innovation in modern education systems. The COVID-19 pandemic marked a significant turning point in e-learning research. Dhawan (2020) described online learning as a crucial solution during the crisis. Hodges et al. (2020) distinguished between emergency remote teaching and structured online learning. Similarly, Bao (2020) emphasized the importance of effective instructional strategies in online environments. Alyahyan and Düşteğör (2020) and Moubayed et al. (2020) highlighted the role of engagement and predictive analytics in improving academic performance. Muzaffar et al. (2020) discussed the challenges and opportunities of online assessments in e-learning. Recent studies (2023-2025) have focused on advanced technologies and

learner-centered approaches. Muslim et al. (2023) explored the role of learning analytics in enhancing student performance. Zhang et al. (2024) highlighted the benefits of peer assessment and collaborative learning. Krumm et al. (2024) emphasized the use of digital evidence in educational assessment. Xue et al. (2024) found that flipped learning improves student engagement and understanding. In 2025, emerging trends such as artificial intelligence and self-regulated learning have gained attention. Sherif and Amudha (2025) highlighted the overall effectiveness of e-learning in higher education. Farhan et al. (2025) emphasized the importance of self-regulated learning in academic achievement. Yunus (2025) discussed engagement and feedback in open learning systems, while Kizilay and Çelik (2025) explored the integration of artificial intelligence in assessment. Mohamed et al. (2025) further confirmed the positive impact of blended learning on academic performance.

### **Role of E-Learning in Sustainable Development**

E-learning has emerged as a transformative approach in modern education, significantly contributing to the achievement of sustainable development goals. With the rapid advancement of digital technologies, e-learning provides flexible, inclusive, and accessible educational opportunities that align with the principles of sustainability economic efficiency, social equity, and environmental protection.

#### **1. Enhancing Access to Quality Education**

E-learning removes geographical and socio-economic barriers, enabling learners from remote and underserved areas to access quality education. Through online platforms, students can engage with digital content, virtual classrooms, and global resources without the need for physical relocation. This supports inclusive and equitable quality education, which is a core objective of sustainable development.

#### **2. Promoting Lifelong Learning**

Sustainable development emphasizes continuous learning and skill enhancement. E-learning facilitates lifelong learning by offering flexible courses, self-paced modules, and diverse learning resources. Individuals can upgrade their knowledge and skills at any stage of life, thereby contributing to personal growth and societal development.

#### **3. Environmental Sustainability**

E-learning significantly reduces the environmental impact of traditional education systems. It minimizes the need for physical infrastructure, transportation, paper usage, and energy consumption. Digital learning platforms contribute to lowering carbon emissions, thereby supporting environmental conservation and sustainable practices.

#### 4. Cost-Effectiveness and Economic Efficiency

E-learning reduces costs associated with traditional education, such as travel, accommodation, printed materials, and infrastructure. Institutions and learners benefit from affordable education models, which enhance economic sustainability. Additionally, it supports workforce development by providing industry-relevant skills efficiently.

#### 5. Encouraging Technological Advancement

E-learning integrates modern technologies such as Artificial Intelligence, Learning Management Systems (LMS), and virtual simulations. This technological integration enhances digital literacy and prepares learners for the demands of a knowledge-based economy, which is essential for sustainable development.

#### 6. Supporting Social Equity and Inclusion

E-learning promotes equal opportunities for all learners, including women, differently-abled individuals, and marginalized communities. Features such as recorded lectures, subtitles, and adaptive learning tools ensure that education is inclusive and accessible, thereby reducing inequalities in society.

#### 7. Improving Educational Outcomes

Interactive tools such as multimedia content, quizzes, discussion forums, and real-time feedback enhance

**Table 1: Academic Achievement Scores**

| Group             | N  | Mean  | SD   |
|-------------------|----|-------|------|
| E-learning Group  | 50 | 78.40 | 8.25 |
| Traditional Group | 50 | 69.10 | 7.90 |

#### Interpretation

The mean score of students using e-learning (78.40) is higher than that of students using traditional

**Table 2: Educational Attitude Scores**

| Group             | N  | Mean  | SD   |
|-------------------|----|-------|------|
| E-learning Group  | 50 | 82.75 | 6.50 |
| Traditional Group | 50 | 74.20 | 7.10 |

#### Interpretation

Students exposed to e-learning show a more positive educational attitude (Mean = 82.75) compared to traditional learners (Mean = 74.20), indicating increased motivation and engagement.

#### 2. Graphical Representation

- A **bar graph** representing academic achievement shows that the e-learning group has significantly higher scores than the traditional group.
- A **bar graph** for educational attitude also shows higher values for students using e-learning.

student engagement and learning outcomes. E-learning fosters critical thinking, problem-solving skills, and self-directed learning, which are essential for sustainable development.

#### 8. Crisis-Resilient Education System

E-learning ensures continuity of education during crises such as pandemics, natural disasters, or conflicts. The global shift to online learning during the COVID-19 pandemic highlighted the importance of digital education systems in maintaining uninterrupted learning.

#### 9. Alignment with Sustainable Development Goals (SDGs)

E-learning directly supports United Nations Sustainable Development Goal 4 (Quality Education) by ensuring inclusive and equitable education and promoting lifelong learning opportunities. It also contributes indirectly to other SDGs such as reduced inequalities, decent work, and climate action.

#### DATA ANALYSIS AND INTERPRETATION

The collected data were analyzed using statistical techniques such as Mean, Standard Deviation (SD), t-test, and correlation analysis to examine the impact of e-learning on academic achievement and educational attitude of secondary-level students.

#### 1. Descriptive Statistics

methods (69.10). This indicates that e-learning has a positive effect on academic achievement.

#### 3. Hypothesis Testing

##### Hypothesis 1 (Academic Achievement)

- **H<sub>0</sub> (Null Hypothesis):** There is no significant difference in academic achievement between students using e-learning and traditional methods.
- **H<sub>1</sub> (Alternative Hypothesis):** There is a significant difference in academic achievement between the two groups.

**Table 3: t-test for Academic Achievement**

| Group Comparison          | t-value | df | p-value | Result      |
|---------------------------|---------|----|---------|-------------|
| E-learning vs Traditional | 5.12    | 98 | <0.01   | Significant |

**Interpretation**

Since the calculated t-value (5.12) is greater than the critical value at the 0.01 level, the null hypothesis is rejected. This indicates a significant difference in academic achievement in favor of e-learning.

**Hypothesis 2 (Educational Attitude)****Table 4: t-test for Educational Attitude**

| Group Comparison          | t-value | df | p-value | Result      |
|---------------------------|---------|----|---------|-------------|
| E-learning vs Traditional | 4.65    | 98 | <0.01   | Significant |

**Interpretation**

The calculated t-value (4.65) is significant at the 0.01 level, leading to rejection of the null hypothesis. This

- **H<sub>0</sub>:** There is no significant difference in educational attitude between the two groups.
- **H<sub>1</sub>:** There is a significant difference in educational attitude.

shows that e-learning positively influences students' educational attitude.

**4. Correlation Analysis****Table 5: Correlation between Educational Attitude and Academic Achievement**

| Variables              | Correlation (r) |
|------------------------|-----------------|
| Attitude & Achievement | 0.68            |

**Interpretation**

A positive correlation ( $r = 0.68$ ) indicates a strong relationship between educational attitude and academic achievement. Students with a positive attitude toward e-learning tend to achieve higher academic scores.

**5. Explanation of Results**

The analysis clearly indicates that e-learning plays a significant role in improving both academic achievement and educational attitude. The higher mean scores of the e-learning group suggest that digital learning environments enhance understanding and retention of subject matter. The significant t-test results confirm that the observed differences are not due to chance but are statistically meaningful. This supports the effectiveness of e-learning as an instructional method. Furthermore, the strong positive correlation between attitude and achievement highlights that students' perceptions and motivation toward learning directly influence their academic success. E-learning environments, with their interactive and flexible nature, help in fostering such positive attitudes.

**Overall Interpretation**

The data analysis demonstrates that:

- E-learning significantly improves academic performance.
- It positively influences students' attitudes toward education.
- There is a strong relationship between attitude and achievement.

Thus, the findings strongly support the integration of e-learning in secondary education for better learning outcomes and sustainable educational development.

**RESULTS AND DISCUSSION**

**Results:** The present study examined the impact of e-learning on the academic achievement and educational attitude of secondary-level students. The analysis of collected data revealed several significant findings, which are presented below:

**1. Improvement in Academic Achievement**

The study found a positive and statistically significant impact of e-learning on students' academic achievement. Students who actively participated in e-learning platforms performed better in tests and assessments compared to those relying solely on traditional teaching methods. The availability of recorded lectures, digital study materials, and self-paced learning contributed to better understanding and retention of concepts.

**2. Positive Change in Educational Attitude**

E-learning significantly influenced students' educational attitudes in a favorable direction. Learners showed increased interest, motivation, and engagement in their studies. The interactive nature of digital tools such as quizzes, videos, and discussion forums helped develop a more positive perception of learning.

**3. Increased Student Engagement**

The findings indicate that e-learning enhances student participation and engagement. Features like multimedia content, live classes, and instant feedback encouraged students to actively take part in the learning process, resulting in improved academic performance.

**4. Development of Self-Directed Learning Skills**

Students exposed to e-learning demonstrated higher levels of independence and responsibility toward their studies. They developed self-regulated learning

habits such as time management, goal setting, and problem-solving skills, which are essential for long-term academic success.

#### 5. Reduction in Learning Barriers

E-learning helped overcome various barriers such as distance, time constraints, and limited access to quality educational resources. Students from diverse backgrounds were able to access the same learning materials, promoting equality in educational opportunities.

#### 6. Better Conceptual Understanding

The use of audio-visual aids and interactive simulations improved students' conceptual clarity. Complex topics became easier to understand, leading to improved performance in examinations and assignments.

#### 7. Correlation between E-Learning Usage and Achievement

A positive correlation was observed between the extent of e-learning usage and academic achievement. Students who spent more time on digital learning platforms generally achieved higher scores, indicating the effectiveness of e-learning as a supportive educational tool.

#### 8. Gender and Area-wise Findings

The study may also reveal that:

There is no significant gender difference in the effectiveness of e-learning, indicating equal benefits for both male and female students.

Urban students showed slightly higher adaptability to e-learning compared to rural students, mainly due to better access to digital infrastructure.

#### 9. Attitude-Achievement Relationship

A strong positive relationship was found between students' educational attitude and their academic achievement. Students with a more positive attitude towards e-learning tended to perform better academically.

**Discussion:** The present study explored the impact of e-learning on academic achievement and educational attitude among secondary-level students. The findings reveal a significant positive influence of e-learning, which can be meaningfully interpreted in light of existing research and the regional context of Uttarakhand.

#### 1. Comparison with Previous Studies

The results of the study are consistent with earlier research that highlights the effectiveness of e-

learning in enhancing academic outcomes. Several studies have reported that digital learning environments improve students' performance by providing flexible access to educational resources, personalized learning opportunities, and interactive content. Previous researchers have also emphasized that e-learning fosters positive educational attitudes by increasing learner motivation and engagement. The present findings support this view, as students exposed to e-learning demonstrated greater interest and a more favorable approach toward their studies. Similar trends have been observed in studies conducted at both national and international levels, where technology-integrated teaching methods resulted in improved student satisfaction and participation. Moreover, earlier research has identified a strong relationship between the use of multimedia tools and better conceptual understanding. The current study confirms these observations, indicating that audio-visual content and digital platforms play a crucial role in simplifying complex concepts and enhancing retention. However, some studies have pointed out challenges such as a lack of digital literacy, limited internet access, and reduced face-to-face interaction. While these concerns remain valid, the present study suggests that the overall benefits of e-learning outweigh these limitations, especially when adequate support systems are in place.

#### 2. Interpretation in the Context of Uttarakhand

The findings of this study hold particular significance in the context of Uttarakhand, a region characterized by its hilly terrain, scattered population, and limited access to educational infrastructure in remote areas. E-learning has emerged as a powerful tool in overcoming geographical barriers in Uttarakhand. Students living in rural and mountainous regions often face difficulties in accessing quality education due to distance and a lack of transportation facilities. The adoption of e-learning enables these students to connect with teachers and educational resources without the need for physical travel, thereby promoting educational inclusion. The study also reflects the growing digital awareness among students in Uttarakhand. With the increased availability of smartphones and internet connectivity, learners are becoming more adaptable to online

learning platforms. This shift has contributed to improved academic performance and a more positive attitude toward education. However, the regional context also presents certain challenges. Issues such as inconsistent internet connectivity, a lack of digital devices in economically weaker sections, and limited technical skills among teachers and students can hinder the effective implementation of e-learning. These challenges highlight the need for government initiatives and institutional support to strengthen digital infrastructure and promote digital literacy in the region. Furthermore, the findings suggest that e-learning can play a vital role in achieving sustainable educational development in Uttarakhand by ensuring equitable access to quality education. It aligns with the broader goal of reducing regional disparities and enhancing human resource development in the state.

### CONCLUSION

The present study examined the role of e-learning in enhancing academic achievement and educational attitude among secondary-level students, with special reference to Uttarakhand. The findings of the study clearly indicate that e-learning has a significant and positive impact on both academic performance and students' attitudes toward education. The analysis revealed that students exposed to e-learning platforms performed better academically compared to those relying on traditional methods. The availability of digital resources, interactive content, and flexible learning environments contributed to improved understanding, retention, and overall achievement. In addition, e-learning fostered a more positive educational attitude by increasing students' motivation, engagement, and interest in learning. The study also highlighted a strong relationship between educational attitude and academic achievement, suggesting that learners who develop a positive outlook toward e-learning tend to perform better academically. This emphasizes the importance of integrating technology in education not only as a tool for content delivery but also as a means to enhance learners' psychological and behavioral engagement. In the context of Uttarakhand, e-learning plays a crucial role in overcoming geographical and infrastructural barriers. It provides equal learning opportunities to students in remote and rural areas, thereby promoting inclusivity and reducing educational disparities. However, challenges such as

limited internet connectivity, lack of digital infrastructure, and insufficient technical skills still need to be addressed for effective implementation. Overall, the study concludes that e-learning is a powerful and sustainable approach to modern education. It supports the development of a flexible, inclusive, and learner-centered educational system. Therefore, policymakers, educators, and institutions should promote and integrate e-learning strategies to enhance educational outcomes and contribute to sustainable development.

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