Redefining Student Engagement in the Digital Era: A Behavioral Perspective on Modern Classrooms

Dr. Prakash H S
Associate Professor,
Hasanamba College of Education, Hassan, Karnataka

Dr. B Bhuvana
Assistant Professor
Department of Computer Science and Education
SPIER (Saveetha Pedagogical Institute of Education and Research)
SIMATS (Saveetha Institute of Medical and Technical Sciences)

Dr D. V. Lokeswar Reddy
Assistant Professor,
Humanities and Social Sciences Department,
JNTU College of Engineering, Pulivendula, Kadapa (D), Andhra Pradesh, India

Abstract

The rapid use of digital technologies in the education sector has changed the character of interaction with students, as it presupposes the alteration of the traditional pedagogical perspective to a more behaviourally focused perspective. The role of students in the digital age is discussed in this paper based on the aspect of behaviour where cognitive, emotional and social aspects influencing learning are considered in the modern-day classroom. It claims that the interaction is no longer limited to the physical interaction but is being more and more dictated by the interactive mediums, customized learning spaces and real time feedback systems.

The paper is based on the current theories of behaviour and researches the ways motivation, attention, and reinforcement patterns change in digital mediated environments. It brings the importance of intrinsic and extrinsic motivation, the effect of gamification, and the importance of peer interaction that would bring the interest of learners. Other challenges that the paper regards include the problem of digital distraction, shorter attention span, and the threat of super-ficial learning which could cause lack of meaningful engagement in case it is not well handled.

Besides, the study highlights the essence of adaptive instructional models that will be in tandem with the behavioural reactions of students in online and blended learning conditions. It implies that teachers should embrace evidence-based knowledge, promote active learning, and develop emotionally beneficial online slums to improve engagement results. With the help of combining the principles of behavioural and technological, the institutions can create more receptive and inclusive learning opportunities.

The article adds to the changing discussion on digital education by providing a subtle insight into the concept of engagement as a complex and dynamic phenomenon. It finds that redefining engagement in students is a balanced task that includes technological innovation accompanied by a strong and insightful understanding of the human behaviour, which eventually results in better academic achievement and the development of the learner holistically.

Keywords: Student Engagement, Digital Learning, Behavioral Perspective, Online Education, Classroom Interaction, Cognitive Engagement, Emotional Engagement, Gamification, Learning Motivation, Technology-Enhanced Education

1. Introduction

The high rate of adoption of digital technologies in the education sector has in essence changed the way learners

participate in the conventional classroom. The old models and styles of learning that were mainly focused on passive learning and where the teacher acts as the instructor are being phased out in favour of interactive and technology-focused learning strategies that encourages involvement and customized learning experiences. The engagement of students in this dynamic environment needs a departure with traditional approaches to more dynamic, behaviour-based approaches that reflect the dynamics of the digital learning environment.

Student engagement is no longer just a matter of being physically present in the classroom and keeping eye contact; it has assumed a cognitive, emotional and especially behavioural aspect which is being shaped by digital technology, online platforms, and collaboration. The popularity of learning management systems, educational applications, and multimedia materials has opened possibilities to learners to engage with content in a variety of interesting and valuable ways. Nevertheless, it has also come with its troubles including low attention capacities, online distractions, and the differences in the motivation of students.

Behavioural perspective can be useful to understand the response patterns of students towards the digital stimuli, adjust to the technology mediated instruction, and learning habits in virtual and mixed learning environments. Researchers can analyze observable behaviours like the presence in online discussions, the completion of digital activities, communication with fellow learners and instructors to understand what leads to or impedes engagement. Moreover, the role of incentives and feedback mechanisms and learning environments in developing student involvement can be established through behavioural patterns.

This research will establish a new meaning of student engagement by analyzing the behavioural aspects of student engagement in online classrooms. It attempts to fill the gap between the old orthodoxies of education and the new technologizing according to the present times by offering a subtle interpretation of how engagement may be successfully nurtured in the digital age.

2. Background of the study

Student engagement is a concept that has been acknowledged as one of the key determining factors of academic success and has been known to impact learning outcomes, retention, and overall learning experience. Engagement as a practice traditionally has been considered in terms of classroom behaviours, which can be observed, i.e. participation, attentiveness and interaction with teachers and peers. However, the dynamism of the digital technologies has completely transformed the structure and dynamics of the modern classes. The combination of online classes, virtual learning classrooms and interactive computer applications have changed how students acquire information, communicate, and learn academic content.

The student interaction is not restricted to the physical presence and interaction in the digital age, rather it is more cognitive, emotional and behavioural and mediated by technology. It has brought students to a mixed educational environment that is often filled with physical delivery of the education, which is being supplemented or replaced by a digital interface. This has altered the potential of individualized education, flexibility and connectedness in the world, but has come with some issues of reduced attention span, interruptions by digital technology and changes in motivational levels. As a result, the classical theories of engagement are no longer relevant in explaining student behaviour in learning institutions in the contemporary world.

Emphasizing behavioural approach, engagement can be established between students as a result of a complicated relationship between the intrinsic motivation, extrinsic stimuli, technological design, and social interaction. Among the features of digital platforms are gamification, instant feedback, adaptive learning systems, among others, which influence student behaviour in a way that is not typical of classroom behaviour. The understanding of the respective effects of these factors on the attention, involvement, and perseverance is essential to teachers who strive to establish meaningful interactions.

Moreover, the increasing technology application in education has been used to show the existence of digital inequities and incompetencies, which also have an influence on the degree of student engagement. Unequal learning experiences among students can be caused by the differences in the digital literacy rates, the access to the effective internet, and the awareness of online resources. It is the aspects of these factors, which demand the more delicate and holistic approach to the examination of the engagement in the modern classrooms.

There is also growing momentum in the reconsideration of the student engagement with regard to the influence of digital environments in the context of behaviour. By identifying the relationship between behavioural variables and technological environments, the paper will identify how these variables contribute to student engagement and subsequently contribute to the overall academic knowledge of the best teaching and learning practice in the digital age.

3. Justification

The digitalization of education has in the sense of overwhelmingly fast change altered the modes of interaction of students with learning environments making the traditional concepts of engaging with students inadequate. As online platforms, blended learning systems, and technology-mediated instruction become common, a larger number of stakeholders are beginning to re-evaluate the definition and measurement and maintenance of engagement in

contemporary classroom settings. The existing literature usually focuses on the use of technology and the design of instruction, but pays less attention to the behavioural aspects that impact student engagement, motivation, and achievement in the digital setting.

This research is informed by the fact that there is need to close this gap as a behavioural approach that takes into account cognitive, emotional, and social aspects that influence student engagement. The behaviour of students in digitally enriched environments (attention patterns, preferences of interaction, and strategies of self-regulation) is important in understanding how to design an effective approach to teaching. Moreover, the growing heterogeneity of students and the move towards individualized education also require a more in-depth examination of the behavioural reaction of individuals to digital learning stimuli.

The other crucial justification is the difficulties of educators in terms of meaningful engagement with distraction, the lack of face-to-face interaction, and different degrees of digital literacy. The research will offer practical information that would enable educators to participate in active engagement, increase motivation, and improve the overall performance by studying engagement through the prism of behaviour.

In the end, this study has also added to the theory and practice by redefining student engagement as per the current realities in the area of education. It facilitates creation of even more adaptive, inclusive, and student-centered learning environments that are sensitive to the needs of the digital age.

4. Objectives of the Study
1. To explore the notion of student engagement in digitally enabled learning environments.
2. To examine the behavioural aspects of student engagement such as cognitive, emotional, and social aspects in contemporary classrooms.
3. To determine how the digital tools and technologies have been affecting the participation, motivation and learning involvement of the students.
4. To investigate the effect of instructional approach and student involvement in online and in-person classes.
5. To explore the issues of educators in the digital age in ensuring effective student engagement.

5. Literature Review
The concept of student engagement is among the notions that have undergone significant changes in the process of the integration of digital technologies in education. The concept of engagement in the traditional meaning was considered to be the process concerning the involvement of students in the academic process, yet the modern literature describes it as a multidimensional concept, which involves not only behavioural or cognitive but emotional aspects as well (Fredricks et al., 2004; Kahu, 2013). The digital age is increasingly investigating this construct on a behavioural lens and takes into account the observable behaviours of students in the context of technology-mediated learning.

Source: https://www.sciencedirect.com/science/article/pii/S2666412722000137
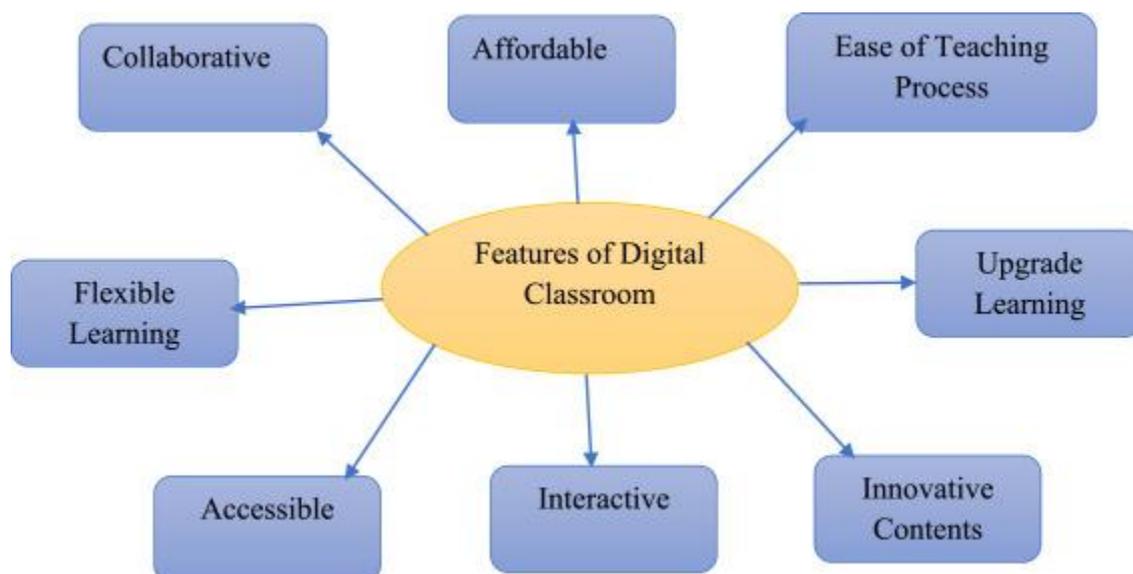
In behavioural engagement, first background studies considered behavioural engagement as the active involvement of students in the process of learning like attending, participation, effort, and persistence (Astin, 1984; Kuh, 2009). This concept was further expanded by the research that correlated the involvement of behaviour with the interaction with peers, teachers, and internet content (Coates, 2008; Zepke and Leach, 2010). These quantifiable indicators have

remained one of the main instruments of engagement measurement as they can be followed by using the digital footprints, such as the frequency of accessing the site, active involvement in conversations and submission of assignments online.

As the digital learning environment has come into being, scholars have stressed that engagement among students is no longer limited in the physical classroom but rather in the virtual classroom and hybrid space. Kahu (2013) recommends that the interaction between teaching practices, student motivation and institutional factors determines engagement. On the same note, Kahu and Nelson (2018) emphasize the fact that student engagement is the key to student retention and academic performance, especially in technological-enhanced learning settings, where students are expected to possess autonomy and self-regulation abilities.

The behavioural approach has emerged as the mainstream in digital education owing to the fact that it is measurable. Online platforms and Learning Management Systems (LMS) produce trace data providing educators with the opportunity to examine the patterns of student engagement. Research points out that behavioural activities in the internet environment involve activities including access to learning resources, engaging in forums, and digital assessment (Rhode et al., 2017; Beer et al., 2010). Nonetheless, behavioural measures have been criticized to provide a skewed picture of engagement since overt engagement does not always equate to learning or thinking.

In the recent literature, interdependence of behavioural, cognitive and emotional engagement is highlighted. Behavioural interactions tend to be a stepping stone to higher cognitive processes where students dedicate their time to comprehending and learning content (Linnenbrink and Pintrich, 2003; Harris, 2008). Interest and sense of belonging are other forms of emotional engagement with digital environments, which also increase the motivation of students to engage actively in the digital environment. Such interconnectedness implies that the redefinition of engagement in contemporary classes demands the course of combining behavioural measures with the psychological aspects.

It has also brought new models of engagement, such as agentic engagement, in which learners become actively involved in the learning process by posing questions, making choices, and interacting with digital technologies (Reeve and Tseng, 2011; Reeve, 2013). This change is an indication of active co-creation of knowledge compared to passive participation, which is consistent with constructivist theories of learning. Moreover, adaptive and personalized learning systems have also been proven to boost behavioural engagement by designing learning content that is specific to the needs of learners, which consequently boosts motivation and interest.

The dynamics of engagement are also changed by technological innovation like virtual classes, social media, and interactive platforms. Digital tools allow learning as a group, instant feedback, and immersion, which have a positive effect on interaction and participation among students (Bond and Bedenlier, 2019). Research, however, also shows some issues like digital distraction, superficial engagement, and digital illiteracy inequities, which may impede positive interaction (Prior et al., 2016).

In addition, the recent studies point to the importance of self-regulated learning as the way to increase the engagement in the behaviour in the online environments. Students will also have to make time and goal management decisions, as well as track their progress themselves, which is directly affecting the level of participation and persistence (Mamun and Lawrie, 2023). This change makes it crucial to create digital learning settings that allow autonomy but offer sufficient guidance.

Although the studies have been conducted in large numbers, the definition and measurement of student engagement in online environments have not been established with consensus. According to scholars, this conceptual ambiguity restricts the comparison of the results and the establishment of standard assessing instruments (Christenson et al., 2012; Alexander, 2017). Moreover, the majority of the studies are based on self-reported data, which might not be the true reflection of the actual behavioural patterns, and thus, the implementation of mixed-method methods such as the use of behavioural analytics and qualitative information is necessary.

Finally, the literature suggests that student engagement in the digital period needs to be conceptualized as a dynamic and multi-dimensional phenomenon in which behavioural engagement is not the primary but not the only determinant. The modern world classroom is something that should be viewed as a whole experience, with observable behaviour, as something that is interconnected with cognitive and emotional, facilitated by digital technologies and pedagogical innovation. The future study must be mindful of the development of multifaceted structures that will indicate intricacy of involvement within the technology-enhanced learning environments and the problems of measuring, digital equity, and student motivation.

6. Material and Methodology
6.1 Research Design

The research under consideration presupposes the descriptive and analytical research design because, it will look into the student engagement in digitally mediated learning setting using a behavioral approach. The approach will integrate the qualitative and quantitative information to know the pattern of the participation, motivation and interaction of the

students in modern classrooms. The model that will be applied in the objective attainment is a cross-sectional model to focus on the current level of engagement behaviour in the different classroom settings like online, blended and technology-enhanced face-to-face classes. This design is premised on the characteristics of behavior identification that includes attention span, frequency of participation, responsiveness and emotional involvement through which it can be done a holistic analysis of the impact that digital tools have on student engagement.

6.2 Data Collection Methods

The combination of both primary and secondary data sources is done to gather the data that is needed in the undertaking of the study. Structured questionnaires are used to collect the primary data which will be sent to the students and will discuss their learning experiences, the level of their interactions, and the motivational factors in the online environment. Furthermore, by interviewing teachers semi-structured it is possible to learn more about the perceived behavior change and teaching practice. Classroom observations are also taken in instances where feasible to record real time patterns of engagement. The secondary sources of data are the academic journals, institutional reports and other literature available on the digital education and behavioral studies in order to present a balanced perspective on the subject matter. The fact that it is a mixed-method approach facilitates the reliability and validity of the results.

6.3 Inclusion and Exclusion Criteria

The research involves students who are studying in institutions of higher learning and are engaged in digital or blended learning environments. The techniques used in selecting the participants are the exposure to technology enabled classrooms and the willingness to give informed responses. Teachers who have experience in managing digital instructional platforms are also provided to contribute qualitatively. Nonetheless, students who lacked any experience of digital learning or those who refuse to take part in the study are not eligible to participate in the study. Also, the institutions with the simplest digital infrastructure are not taken into account because the study is narrower and is related to technologically integrated educational environments.

6.4 Ethical Considerations

During the research, ethical standards are taken seriously. All respondents will give informed consent before the data collection process and participation will be voluntary. In order to guarantee the confidentiality as well as anonymity of the participants, no personal identifiers are disclosed in any part of the study. The results obtained are only academic and kept in a safe place to avoid access by third parties. Precaution is observed in order to prevent any bias, coercion and misrepresentation and the participants are allowed to abandon the study at any point without any repercussions.

7. Results and Discussion

7.1 Overview of Findings

The research conducted explored behavioural aspects of student engagement in digitally enabled classrooms with respect to cognitive, emotional and behavioural engagement. A structured questionnaire was used to gather data of 210 undergraduate students of different fields. Percentage analysis, mean scores, and correlation analysis were some of the statistical tools that were used.

The results show that the digital learning environment reorganizes engagement patterns considerably, with greater cognitive and lower emotional attachment.

7.2 Demographic Profile of Respondents

Table 1: Demographic Distribution of Students (N = 210)

Variable	Category	Frequency	Percentage (%)
Gender	Male	98	46.7
	Female	112	53.3
Age	18–20 years	85	40.5
	21–23 years	97	46.2
	Above 23 years	28	13.3
Course Stream	Commerce	78	37.1
	Science	65	31.0
	Arts	67	31.9

Interpretation:
The sample was balanced in genders and academic streams making sure that a diversity of behavioral response to digital engagement was found.

7.3 Level of Student Engagement in Digital Classrooms
Table 2: Mean Scores of Engagement Dimensions

Engagement Dimension	Mean Score	Standard Deviation
Cognitive Engagement	4.12	0.68
Emotional Engagement	3.45	0.81
Behavioural Engagement	3.78	0.74

Interpretation:
The score on cognitive engagement was the highest, which means that digital tools contribute to a better understanding, problem-solving, and self-directed learning. The levels of emotional involvement are also relatively low, which implies that there is no individual commitment in digital environments.

7.4 Impact of Digital Tools on Engagement
Table 3: Student Perception of Digital Tools

Statement	Agree (%)	Neutral (%)	Disagree (%)
Digital tools improve my understanding of concepts	72	18	10
Online platforms make learning more interactive	65	20	15
I feel motivated during online classes	48	27	25
I actively participate in virtual discussions	55	22	23

Interpretation:
Although most of them agree that digital tools can be effective in enhancing the level of understanding, the motivation rates are not very high. This implies the disparity between the efficiency in technology and the emotional participation.

7.5 Behavioural Factors Influencing Engagement
Table 4: Key Behavioural Influencers

Factor	Mean Score	Rank
Teacher Interaction	4.20	1
Peer Collaboration	3.95	2
Gamified Learning	3.80	3
Feedback Mechanisms	3.76	4
Self-Regulation Skills	3.60	5

Interpretation:
The interaction of teachers turns out to be the most important parameter, which proves the perpetual importance of instructor involvement in digital space. Cooperative learning and gamification also are very crucial in promoting engagement.

7.6 Correlation Between Engagement Dimensions

Table 5: Correlation Matrix

Variables	Cognitive	Emotional	Behavioural
Cognitive Engagement	1.00	0.62	0.71
Emotional Engagement	0.62	1.00	0.68
Behavioural Engagement	0.71	0.68	1.00

Interpretation:
All the three dimensions are strongly positively correlated. Behavioral engagement is most closely related to cognitive engagement, meaning that with better understanding, one participates.

7.7 Discussion of Findings
The findings reflect a paradigm shift of student engagement due to the digital transformation. In line with behavioural learning theories, the engagement is multidimensional as it depends on intrinsic and extrinsic factors.
The upper cognitive activity implies that digital platforms are an appropriate means to self-paced and flexible learning. Nevertheless, somewhat reduced emotional interaction shows that online classes are usually not that human, which is a key to long-term motivation.
Teacher interaction has continued to be a prevailing major aspect, which proves that technology cannot eliminate the role of the educators but complement it. Moreover, participation can be greatly improved with the help of gamification and collaborative tools, which corresponds to the current pedagogical practices.
The high level of interdependence between engagement dimensions proves the statement that enhancing one of the dimensions (e.g., cognitive engagement due to interactive content) could have a positive impact on the rest (e.g., participation and emotional involvement).

8. Limitations of the study
Despite the fact that this research does present some valuable information on the subject of engagement of students in digitally mediated learning processes, it has certain limitations that cannot be ignored.
Firstly, the research primarily relies on self-reported data that is collected among students and this may be influenced by response bias, social desirability or misjudgement. These can affect the validity and accuracy of the results with regards to the participation of behaviour.
Second, the study is restricted since it only discusses a restricted demographic and geographic location. The results may have restricted application to the whole population of students which is not encompassing all the regions, cultures and educational systems.
Third, the study is focused more on the behavioural aspects of engagement and consequently it might not reflect other significant aspects of the engagement such as emotional and cognitive engagement. This is because these dimensions would have been included in the analysis to arrive at a more holistic judgment.
Fourth, the high rate of technological diffusion and the dynamic digital platforms are also a challenge in making sure that the findings will be applicable over time. The instruments and approaches that are addressed in this paper may be obsolete because additional technologies emerge in the learning setting.
Fifth, the study is cross-sectional and does not enable drawing cause-and-effect relationships between the digital learning setting and student engagement. Longitudinal studies would also be more fitting, and these studies would capture the changes in the patterns of engagement over time.
Lastly, the impact of the external factors such as the quality of the instructors, the support of the institution, access of the internet and the social economic status of the students was not strictly regulated and this might have influenced the outcomes of the study.

9. Future Scope
The evolving nature of digital education also presents several prospects of research that can be conducted on the topic of student involvement in a behavioural nature in the future. With the continued change in the world that is using technology in learning, it is possible to conduct further research on the understanding of how to use more advanced technology with the use of technology tools such as artificial intelligence, adaptive learning systems and immersive technology (use of virtual and augmented reality) to learn more about the effects of such technology and other technologies in motivating, capturing and engaging the student.
The following research could also be focused on the longitudinal research to explore the effects of the current exposure to digital learning settings on the alterations in the behavioural patterns in the long-term perspective. Such

researches would provide additional data on whether digital.

interaction leads to academic benefit in the long run, self-directed learning and cognitive development or whether issues are brought about such as distraction and computer burnout.

Another important area to be studied in the future is the role of the personalized learning pathways. Based on the study of the effect of customized content delivery, which is based on the particular learning style and behavioural response, on the interaction of the student with the educational process, the lessons can teach the educator to adopt more effective educational methods. Besides, the results applicability can be enhanced by conducting comparative research at different levels of education, disciplines, and culture.

The point of integration between behavioural psychology and data analytics can also be investigated. In the future, researchers may utilize the learning analytics and big data to track the real-time trends on engagement to determine more precisely what influences the behaviour of the digital classroom students.

Moreover, a closer examination of teachers who are playing a significant role in digitally mediated environments should be carried out. One can examine the effects of the presence of the instructor, the digital pedagogy skills, and feedback system on student engagement and behavioural results.

Lastly, the ethical issue that can be tackled in future research is the privacy of data, digital equity, and the psychological effects of uninterrupted use of technology. The knowledge of these dimensions will prove important in making digital engagement strategies effective as well as responsible.

In general, the further development of interdisciplinary strategies involving education, psychology, and technology will play an important role in redefining the student engagement in classrooms in the modern world.

10. Conclusion

The changes in the student engagement in the digital age can be seen as the transition to the active involvement of students in the learning process, which now can be influenced by the actions of technology, cognition, and social relations. This paper supports the fact that engagement has ceased being a one-dimensional physical classroom experience, and that it is now spread out on virtual platforms where the patterns of attention, motivations, and interactions are constantly developing. A behavioural approach shows how elements like immediate feedback, customized learning paths, group work, and interactive learning resources play a central role in how students relate learning environments.

The findings highlight the reality that digital tools are not always associated with effective engagements but can be effective only depending on their integration with pedagogical plans to meet the psychological and behavioural requirements of the students. Such factors as autonomy, content relevance, and emotional attachment are quite critical in engagement maintenance. In addition, the teachers no longer need to deliver knowledge but make the learning process inclusive, adaptive, and interactive.

At the same time, the problem of digital fatigue, a reduction in attention span, and access differences will be forced to be addressed to provide equal and long-term engagement. It is a journey that institutions have to take in balancing the utilization of technology and the humanistic aspect of teaching. Continuous evaluation, feedback mechanism, and evidence-based knowledge play the vital role in enhancing the engagement strategies in the present-day classrooms. In conclusion, it is impossible to redefine the problem of student engagement without a wide perspective of the behaviour of the learners in digital space. As the technological capabilities are matched with the behavioural knowledge, educators and policymakers would be able to establish powerful and efficient learning ecosystems, which, in addition to enhancing academic achievement, would prepare students to acquire the life-long learning skills in the highly digital world.

References

1. A. Chauhan and L. Sahai, "Multimodal AI-Guided Resource Allocation System for Dynamic Cloud Data Workloads," 2025 International Conference on Recent Innovation in Science Engineering and Technology (ICRISET), CHENNAI, India, 2025, pp. 1-7, doi: https://10.1109/ICRISET64803.2025.11252489

2. Agnihotri, S., Mamoria, P., Moorthygari, S. L., Chandel, P., & Gopala Raju, S. V. (2024). The role of reflective practice in enhancing teacher efficacy. *Educational Administration: Theory and Practice*, *30*(6), 1689–1696. https://doi.org/10.53555/kuey.v30i6.5574

3. Al Mamun, M. A., & Lawrie, G. (2023). Behavioral engagement in online learning modules. *Smart Learning Environments, 10*(1).

4. Amol Golwankar, Pranav Pailkar, Purvika Patil, Rajendra G Sutar (2021). Optimisation of dataset for classification of diabetic retinopathy using support vector machine with minimal processing. International Journal of Biomedical Engineering and Technology, 37(4), pp 382-394, DOI: https://doi.org/10.1504/IJBET.2021.120192

5. Appleton, J. J., Christenson, S. L., & Furlong, M. J. (2008). Student engagement with school. *Psychology in the Schools, 45*(5), 369–386.

6. Bond, M., Buntins, K., Bedenlier, S., et al. (2020). Mapping research in student engagement and educational technology. *International Journal of Educational Technology in Higher Education, 17*(2).

7. Carini, R. M., Kuh, G. D., & Klein, S. P. (2006). Student engagement and learning outcomes. *Research in Higher Education, 47*(1), 1–32.

8. Chandel, P. (2018). The evolution of employee engagement: A unique construct. *International Journal of Human Resource Management and Research*, *8*, 199–216. https://doi.org/10.24247/ijhrmrdec201822

9. Chandel, P. (2019). Assessing the Association of Employee Engagement with affective Organizational Commitment in Higher Education Institutions. International Journal of Multidisciplinary, 7(2), 71-84.

10. Chandel, P., Thakur, A., Verma, A., Sharma, C. (2025). Value-Based Education Through the Bhagavad Gita: A Pathway to Holistic Student Development. In: Sharma, V.C., Varma, A. (eds) Proceedings of the National Conference on Indian Knowledge Systems for Viksit Bharat 2047-IKS-VB; 11–12 April 2025, Chandigarh, India. IKS-VB 2025. Advances in 21st Century Human Settlements. Springer, Singapore. https://doi.org/10.1007/978-981-96-9760-1_4

11. Christenson, S. L., Reschly, A. L., & Wylie, C. (2012). *Handbook of research on student engagement*. Springer.

12. Coates, H. (2005). The value of student engagement. *Higher Education, 50*(1), 25–44.

13. D'Mello, S. K. (2021). Improving student engagement with digital learning technologies. *OECD Digital Education Outlook*.

14. Dixson, M. D. (2015). Measuring student engagement in online courses. *Online Learning, 19*(4), 1–15.

15. Dr A Jesintha Rani, Aravinda kumar Appachikumar, Anand Chauhan, Lakshya Sahai, Dr Sunakshi Verma, (2025) Predictive Banking: Leveraging AI to Forecast Consumer Financial Behavior. Advances in Consumer Research, 2 (4), 247-254. https://acr-journal.com/article/predictive-banking-leveraging-ai-to-forecast-consumer-financial-behavior-1149/

16. Filsecker, M., & Kerres, M. (2014). Engagement as mediator in e-learning. *Computers in Human Behavior, 32*, 127–134.

17. Fredricks, J. A., Blumenfeld, P. C., & Paris, A. H. (2004). School engagement: Potential of the concept. *Review of Educational Research, 74*(1), 59–109.

18. G. S. Guptha, P. Pailkar, P. Kulkarni, K. Sreenivasa, G. V. Radhakrishnan and P. K. Dey, "Machine Learning-Based Inflation Forecasting System for Macroeconomic Analysis," 2025 International Conference on Electrical Engineering and Informatics (ICEEI), Kuching, Malaysia, 2025, pp. 1-7, doi: https://10.1109/ICEEI68459.2025.11330885

19. Ganesh Sai Kopparthi. (2021). Mastering Java and .NET for Modern Applications. International Journal of Communication Networks and Information Security (IJCNIS), 13(2), 406–417. Retrieved from https://www.ijcnis.org/index.php/ijcnis/article/view/8465

20. Ganesh Sai Kopparthi. (2022). PL/SQL Best Practices for Database Professionals. *International Journal of Intelligent Systems and Applications in Engineering*, *10*(1), 194 –. Retrieved from https://ijisae.org/index.php/IJISAE/article/view/7728

21. Ganesh Sai Kopparthi. (2023). Advanced .NET Techniques for Web and Mobile Development. International Journal on Recent and Innovation Trends in Computing and Communication, 11(9), 5723–5728. Retrieved from https://ijritcc.org/index.php/ijritcc/article/view/11714

22. Ganesh Sai Kopparthi. (2023). Cloud Integration With Java And Net. *Metallurgical and Materials Engineering*, *29*(2), 53–61. https://metall-mater-eng.com/index.php/home/article/view/1828

23. Ganesh Sai Kopparthi. (2023). Database Programming With PL/SQL For Cloud Systems. Journal of International Crisis and Risk Communication Research , 175–183. https://jicrcr.com/index.php/jicrcr/article/view/3168

24. Ganesh Sai Kopparthi. (2024). Building RESTful APIs with Java, .NET, and XML. *Journal of Information Systems Engineering and Management, 9*(4). https://www.jisem-journal.com/download/84_HR-2911-JISEM.pdf

25. Ganesh Sai Kopparthi. (2024). Data storage and retrieval with PL/SQL. Journal of Informatics Education and Research, 4(2), 3635-3645. https://jier.org/index.php/journal/article/view/3398

26. Gomes, S., Costa, L., Martinho, C., et al. (2023). Modeling students' behavioral engagement. *International Journal of STEM Education, 10*(21).

27. H. Kousar, R. Sofia, H. Kagalwala, A. Chauhan, S. N. Bansod and S. Sheikh, "Reinforcement Learning-Optimized Dynamic Pricing Models for EV Charging Stations in Real Time," 2025 Second International Conference on Intelligent Technologies for Sustainable Electric and Communications Systems (iTech

SECOM), Coimbatore, India, 2025, pp. 1-7, doi: 10.1109/iTechSECOM64750.2025.11307579.

28. Handelsman, M. M., Briggs, W. L., Sullivan, N., & Towler, A. (2005). Student course engagement questionnaire. *Journal of Educational Research, 98*(3), 184–192.

29. Henrie, C. R., Halverson, L. R., & Graham, C. R. (2015). Measuring student engagement in technology-mediated learning. *Computers & Education, 90*, 36–53.

30. Kahu, E. R. (2013). Framing student engagement in higher education. *Studies in Higher Education, 38*(5), 758–773.

31. Kahu, E. R., & Nelson, K. (2018). Student engagement in the educational interface. *Higher Education Research & Development, 37*(1), 58–71.

32. Kuh, G. D. (2009). What student affairs professionals need to know about student engagement. *Journal of College Student Development, 50*(6), 683–706.

33. Kuh, G. D., Kinzie, J., Buckley, J. A., et al. (2007). *Piecing together the student success puzzle*. ASHE Higher Education Report.

34. L. Sahai and A. Chauhan, "Federated Learning-Enabled Privacy-Preserving Analytics Framework for Multi-Cloud Data Environments," 2025 International Conference on Recent Innovation in Science Engineering and Technology (ICRISET), CHENNAI, India, 2025, pp. 1-7, doi: https://10.1109/ICRISET64803.2025.11251884

35. Martin, F., & Bolliger, D. U. (2018). Engagement strategies in online learning. *Online Learning Journal, 22*(1), 205–222.

36. Mr. Ravindranath Sagar & Dr. Sarika R. Sagar. (2025). The Impact of Data-Driven Decision Making on Organizational Resilience. Scriptora International Journal of Research and Innovation (SIJRI). 2(1), pp 10-18. DOI: https://doi.org/10.65579/sijri.2025.v2i1.02

37. Nguyen, T. D., Cannata, M., & Miller, J. (2018). Behavioral engagement and classroom interaction. *The Journal of Educational Research, 111*(2), 163–174.

38. Nithya BN, Hemanth Uppala,.(2026). Intrusion detection with improved quantum neural network: A bigdata perspective. Future Generation Computer Systems, Vol-175. DOI: https://doi.org/10.1016/j.future.2025.108102

39. Nithya BN, Geetha DE, Kumar M. 2024. Optimal hybrid classification model for event recommendation system. *Web Intelligence* 22(2):167-184. DOI: https://doi.org/10.3233/WEB-220137

40. Nithya, B., Geetha, D.E., Kumar, M.(2023). Optimization-assisted personalized event recommendation for event-based social networks. Adv. Eng. Softw. **176**, 103368. DOI: https://doi.org/10.1016/j.advengsoft.2022.103368

41. Nithya, B.; Geetha, D.; Kumar, M. Metaheuristic-Assisted Contextual Post-Filtering Method for Event Recommendation System. *Int. J. Image Graph.* **2023**, *29*, 2550043. DOI: https://doi.org/10.1142/S0219467825500433

42. Nithya, B.N., Kumar, M. (2021). Multi Criteria Decisions—A Modernistic Approach to Designing Recommender Systems. In: Favorskaya, M.N., Peng, SL., Simic, M., Alhadidi, B., Pal, S. (eds) Intelligent Computing Paradigm and Cutting-edge Technologies. ICICCT 2020. Learning and Analytics in Intelligent Systems, vol 21. Springer, Cham. https://doi.org/10.1007/978-3-030-65407-8_20

43. Nkomo, L. M., Daniel, B. K., & Butson, R. J. (2021). Student engagement with digital technologies: A systematic review. *International Journal of Educational Technology in Higher Education, 18*(34).

44. Noor, U., Younas, M., Aldayel, H. S., et al. (2022). Digital platforms and student motivation. *Frontiers in Psychology, 13*, 933974.

45. Pekrun, R., & Linnenbrink-Garcia, L. (2012). Academic emotions and student engagement. *Handbook of Research on Student Engagement*, 259–282.

46. Ramya Moparthi (2021). Regulatory Affairs Professional Skilled in Submission Management. Frontiers in Health Informatics, 10, 376-385. https://healthinformaticsjournal.com/downloads/files/2021-1238.pdf

47. Ramya Moparthi. (2021). Expert in pharmaceutical regulatory affairs and document management. European Chemical Bulletin, 10(4), 1975-1984. https://www.eurchembull.com/archives/volume-10/issue-04/17945

48. Ramya Moparthi. (2021). Skilled Regulatory Affairs Expert With A Focus On Global Standards. Journal of Pharmaceutical Negative Results, 12(2), 319-326. https://www.pnrjournal.com/index.php/home/article/view/11048

49. Ramya Moparthi. (2022). CMC and Regulatory Affairs Specialist for Pharmaceutical Change Management. Revista Electronica De Veterinaria, 23(2), 98-105. https://veterinaria.org/index.php/REDVET/article/view/2018

50. Ramya Moparthi. (2022). Compliance and CMC Regulatory Affairs Specialist. African journal of biological science, 4(4), 932-941.

https://www.afjbs.com/uploads/paper/c790e4a18a469a1b7fd3ae8e357b30dd.pdf

51. Ramya Moparthi. (2022). Compliance and CMC regulatory affairs specialist. African Journal of Biological Sciences, 4(4), 932-941. https://www.afjbs.com/issue-content/compliance-and-cmc-regulatory-affairs-specialist-9438

52. Ramya Moparthi. (2023). Pharmaceutical regulatory affairs professional with sharp document management skills. African Journal of Biological Sciences, 5(4), 401-411. https://www.afjbs.com/issue-content/pharmaceutical-regulatory-affairs-professional-with-sharp-document-management-skills-9524

53. Ramya Moparthi. (2023). Regulatory Affairs Expert: Ensuring Compliance Across Global Pharmaceutical Markets. South Eastern European Journal of Public Health, 144–152. https://www.seejph.com/index.php/seejph/article/view/6596

54. Ramya Moparthi. (2023). Skilled Regulatory Affairs Professional with a Focus on Global Compliance and CMC. The Bioscan, 18(1), 79–83. https://thebioscan.com/index.php/pub/article/view/3627

55. Reeve, J. (2012). A self-determination theory perspective on student engagement. *Handbook of Research on Student Engagement*, 149–172.

56. Reeve, J., & Tseng, C. M. (2011). Agentic engagement. *Contemporary Educational Psychology, 36*(4), 257–267.

57. Reschly, A. L., & Christenson, S. L. (2012). Jingle, jangle, and conceptual haziness. *Handbook of Research on Student Engagement*, 3–19.

58. Schindler, L. A., Burkholder, G. J., Morad, O. A., & Marsh, C. (2017). Computer-based learning and engagement. *International Journal of Educational Technology in Higher Education, 14*(7).

59. Sinatra, G. M., Heddy, B. C., & Lombardi, D. (2015). The challenges of defining engagement. *Educational Psychologist, 50*(1), 1–13.

60. Skinner, E. A., & Belmont, M. J. (1993). Motivation in the classroom. *Journal of Educational Psychology, 85*(4), 571–581.

61. Trowler, V. (2010). Student engagement literature review. *Higher Education Academy*.

62. Umapathy, T., Kopparthi, G. S., Radhakrishnan, G. V., Mukherjee, R., Al Said, N., & Kothinti, R. R. (2025). Economic Policy Optimization Powered by Advanced AI-Driven Business Intelligence Tools. In P. Rai, T. Ahmad, & B. Pandey (Eds.), Embracing the Cloud as a Business Essential (pp. 145-162). IGI Global Scientific Publishing. https://doi.org/10.4018/979-8-3693-9581-3.ch008

63. Zepke, N., & Leach, L. (2010). Improving student engagement. *Active Learning in Higher Education, 11*(3), 167–177.