



e-ISSN: 2319-8753 | p-ISSN: 2320-6710

IJRSET

International Journal of Innovative Research in
SCIENCE | ENGINEERING | TECHNOLOGY

INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

Volume 10, Issue 2, February 2021

ISSN INTERNATIONAL
STANDARD
SERIAL
NUMBER
INDIA

Impact Factor: 7.512

9940 572 462

6381 907 438

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Building Smart Education in Pandemics

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ABSTRACT: Traditional learning pedagogy was centered around the instructor and a standardized approach to education. There was a shift to a more available and adaptable form of presentation through the Internet. With the novel coronavirus (COVID-19) pandemic outbreak, many schools adopted a complete online form of education. This disrupted the teaching and learning styles, and how the skills are acquired. It also showed how lacking the current online pedagogy is and the need for a more inclusive smart education pedagogy and techniques. The aim of the paper is to review the literature and to propose a smart education pedagogy that not only looks into the inclusiveness but can be adapted to a future pandemic situation without compromising on the standards of education.

KEYWORDS: Education in pandemics, Inclusive smart education, Pedagogy, Smart education

I. INTRODUCTION

Education is an important aspect of human life wherein it is the process of acquiring knowledge, skills, beliefs, and habits. It was also identified as a fundamental human right by United Nations (UN). Not every child is able to attend a school and access education. The UN formulated a Sustainable Development Goal 4 towards a more inclusive and accessible education. However, the disruption caused by the COVID-19 pandemic impacted the lives of many students and teachers alike, affecting the process of learning.

The pandemic has called for the closure of several schools and without any advanced notice has moved to an online mode of education, pushing the inequalities between technological rich and poor further apart. There are students with inaccessible internet, with disabilities, and other factors that require our attention. This has also led to the understanding that the online mode of education is lacking in many ways.

In the situation of COVID-19, many institutions have adopted face-to-face online teaching and other 'innovative' methods [24], an unprecedented paradigm shift. However, the education supplied is not so 'smart', that is, it still lacks the robustness and adaptiveness that current technological advancements boast of.

Traditional learning methods are very difficult to apply from a learner's perspective in an online learning environment. The thriving features identified in a traditional learning environment are missing in online mode of education leading the learner's lack of motivation to study and communicate with peers. There is also a booming black-market in education. Some parents have also removed their children from schools to home tutoring.

The most impacted are the learners with physical disabilities, who are attention-deficient, and those who find it challenging without an assistance. They may find the current situation as a barrier to their learning process, even if provided with properly functioning internet access and computer systems. This is because many online platforms are not following the accessibility standards.

The paper is a study to draw boundaries between online education and smart education, to understand the role of computational intelligence in the development of smart and inclusive education, and to propose a smart learning system that overcomes the difficulties raised in the pandemics.

II. RELATED WORKS

1. Traditional Learning

A traditional learning environment can be pictured as a classroom with the instructor determining the flow of control and availability of content to the students. Physical presence of both the teachers and students are extremely important. The content is the main focus through the entire class and not on whether the learner was able to grasp it, or if any skill development is involved [1]. As a correction, it is more of a teaching environment centered around the instructor.



The classrooms then moved to a technology enabled environment and to a blended learning system. This technology-enabled environment is strictly under the authority of institution and/or the teacher [1].

2. Online Learning

Internet technologies has helped in offering education to a larger number than traditional schools could have. Reasons for its popularity accounting to increased access to quality education, support in adult literacy, and access of relevant and up-to-date quality content [2]. This has further been developed as the role of teacher changed from a lecturer aimed at supplying knowledge to a guide allowing the development of skills [2].

Many institutions have adapted to the online education by supplying a virtual learning environment, learning management system (LMS) [3] and massive open online courses (MOOC) [4], while also contributing and attributing to other learning platforms like Khan Academy, Coursera, edX, and India's Swayam. The transition towards online education adopt the existing pedagogy of traditional classrooms.

Digital technology has also enabled education to be learner centric and supply as an individualized activity. Other aspects like collaboration, people's emotions, underlying pedagogy, learner's attitudes, teacher's beliefs among other variables form a digital learning environment. However, this only forms a part of the learner's environment and not the learning environment itself.

3. Smart Learning Environment

Smart education has no proper definition [7] however is concluded to be the application of computational intelligence technologies as instruments for the development of an adaptive, inclusive, efficient, and collaborative learning environment [7, 8]. It is comprised of two views- technology and techniques. It fosters creativity and push frontiers of education through the use of smart and ubiquitous technologies using the social techniques to provide a learning environment for the learner [6, 7, 8].

Artificial intelligence is an effective technology to provide smart education in smart cities with large amounts of digital footprints available. There is progress towards making 'smart' online education while applying adaptive learning styles [9, 10], developing a knowledge repository and contents [8, 11], predicting the learning processes using machine learning algorithms [12], in evaluation [8, 13], and problem identification [12, 14, 15].

Data mining in education and learning analytics [12] are upcoming research areas. Inclusive of other computational intelligence techniques and algorithms- to analyze the data and to improve the learning processes. Predictive analytics is used to predict learner's outcome and learner's behaviors [16]. Sentiment analysis and social mining is used in understanding feedback and comments received about instructor to improve the quality and engagement [17, 18].

III. GAP ANALYSIS

There are different studies on smart education, but it is mostly on how the technologies can be applied separately for education. This is however not focused enough on the needs and motivations of students. Learners, especially visually impaired and other disabled, attention deficient and autistic students need not have the motivation to sit through or even open the platform if there is no accessibility and adaptive environment for them to thrive.

Routine feedback which is entered manually throughout the class and in between classes could be a distraction. Personalization and adaptation need to be dynamic as the initial personality traits would not be enough to accommodate the growing changes in the students.

The open practices studied and proposed in reference [24] are for the current pandemic solution- the complete online mode of education. There are no proper models that can address inclusivity in the future education, the smart education.

IV. PROPOSED SMART EDUCATION

Clearly, online education is accessed through internet technology available to a larger population with or without any supervision. Smart education, on the other hand, is more about bringing the traditional classrooms to a smart environment with the utilization of smart technologies and techniques to nurture an innovative learning atmosphere for the learners.

The person who is benefitting from the model is the learner and the society at large. The model is proposed with the needs of learner in mind.

1. Assumptions and roles

The assumptions that the system is situated in an urban setting with all the required resources, data, devices, and internet connectivity.

Entities in the proposed smart education is the instructor and the learner. All the entities that is the instructor and the learners have access to the system. The role of the instructor is to control the smooth flowing of content and to monitor the engagement of the learners.

2. The model

Smart environment [7] is one which is immersive, and the learning experience is integrated to his/her environment. Here, the learner is the focus and not the instructor or the content. The environment using the smart technologies are aimed at providing a context-aware, adaptive, ubiquitous, and accessible experience. An immersive ‘smart’ environment with persuasive technology and design techniques, collaborative, and open discussion forums to keep the students engaged and motivated is proposed. The model uses software engineering model of SCRUM methodology.

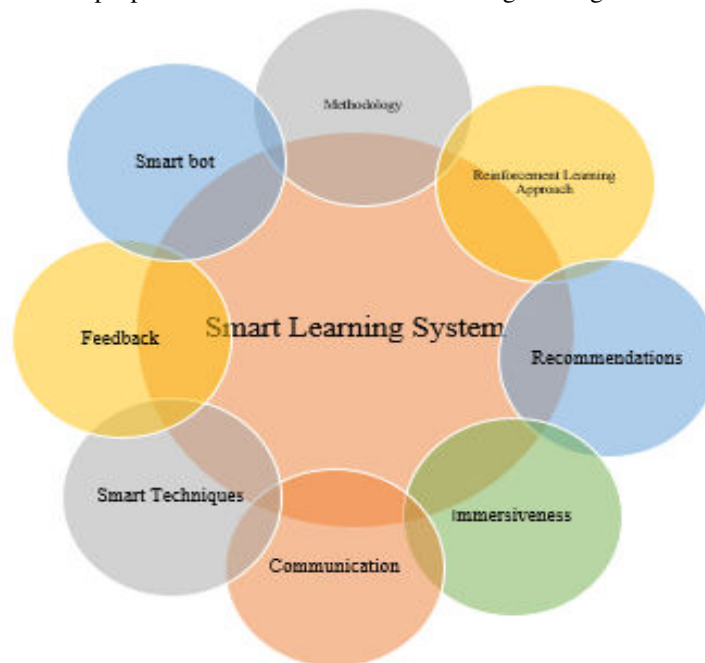


Figure 1: Proposed Smart Learning System Features

2.1. Methodology

The software engineering methodology, SCRUM is proposed for the model. This is an improved Agile and Rapid Application Development. This model focuses on developing of macro features at the same time developing micro features. The model also works through team management techniques which can be applied on the learning system itself.

The systems require for addition of features as each feature is explored by the learner. The values of a Scrum team are aligned to the values of the proposed smart education model.



Figure 2: Values of Scrum Methodology [28]

2.2. Reinforcement Learning

Reinforcement learning approach to cluster the learners and to learn the pedagogical achievements possible in the existing system. Based on the clusters and features identified, the content is then adapted to simulate the learning styles [19].

2.3. Recommendations

Recommendations of the courseware to the learners based on the content, interests, prior experience, cognitive ability, behavioral patterns, and other characteristics identified through clusters. These characteristics identified is fed into a machine learning model to develop a recommendation system [20].

2.4. Immersiveness

Immersive technology to provide an immersive environment through virtual reality and the content through augmented reality. Virtual reality can help in delivering an environment that fosters the delivery of the goals and becomes the learning environment. Augmented reality can help in presenting the sense of feel, thereby giving the learners an access to interact with the content rather than just observing as is in other environments. This immersiveness is the very basis of keeping the students engaged. Additionally, a haptic-based information rendering [21, 22] can be used to give special needs learner an immersive sense.

2.5. Communication

The communication process- rather than a teacher-to-learner, a two-way and peer-to-peer communication using principles of social network analysis [12,14], a connective environment similar to SNS [15], and a distributed peer-to-peer architecture (it is assumed that all peers have access to same technology).

2.6. Smart education techniques

Techniques are applied with respect to the sentiment and behavior captured. It will also depend on the target learner group. These techniques can be developed aligned to the reinforcement learning approach in education.

2.7. Feedback

Feedback, unlike clickers and SNS used in references [15, 17], an integrated sub-environment should be developed. Otherwise, it could be a cause of distraction and reduce the attention span of the classes conducted. It can also lead to the learners giving incorrect responses intentionally or unintentionally. Behavioral pattern and emotion recognition can be used to get real-time feedback on the content, to assess the understanding of learners, to adapt to the cognition ability, and to develop the techniques.



2.8. Smart bot

A smart personalized bot to connect the learners to the instructors and the system. These bots are controlled by the instructor. The interaction between the learners and their bots can be summarized and sent to the instructor for reviewing at a later time. For further interaction, the learners initiate the conversation through the bots.

V. RESULTS AND DISCUSSION

The proposed model is adapting to the environment and capturing data in real-time. While keeping the assumptions in mind and nullifying failures, the model is proposed. The model is centered on the benefiter, the learner. The literatures focus on how the content of the course can be adapted and how the teachers can stream the content. There was no study on a learner's perspective, how incapacitated online education is in a pandemic situation where the resources are very limited and how easily the shift can be attained.

One important point to be noted is the requirement for the collaborative development of the model across various departments.

VI. CONCLUSION

A smart education pedagogy is proposed, that is developed from the open pedagogy for online education, to the pandemic situation where physical interaction is limited yet education is unlimited.

More research needs to be done on how to make the smart education principles more accessible to learners with no advanced devices and into the ethical delivery of the content using unsupervised machine learning algorithms.

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