Active Learning Strategies for Effective Online/Offline Teaching

Abstract— **Learning is a holistic process that involves several key components based on two-way interaction and transfer of knowledge between the learner and surroundings. Given the developments in technology and pandemic situation, finding the right mix of traditional and new learning styles is paramount. Traditional teaching and learning process have failed to create the necessary connect among the millennial learners. Therefore, a judicial use of traditional teaching techniques with the relevant technology will make for an effective tool in converting the millennial student into an active learner. Active learning approach is the first step in making learning an organic process. In-class techniques like Polls, Fish Bowl, Thin Pair Share, etc., are suitable for offline/online classes and for students of different personalities and backgrounds. This approach will not only foster exchange of ideas among peers through discussions, case studies and role plays, but also cater to individual learning styles. Various teaching techniques that can be employed to better deliver the course curriculum are discussed in this paper. The outcome of employing such an approach will not only promote higher order thinking skills, engaging in deep learning, but also facilitate better transfer of knowledge. As there is no standard protocol to follow in technical higher education teaching, this concept paper is the first step in incorporating learner centric teaching that can bring better congruity and consistency in specific higher education fields.**

Keywords— **Active learning; Blended learning; Experiential learning; Information communication technology; Millennial learner**

I. INTRODUCTION

Since the technology boom in late 90s and early 2000s, access to information that was privy to an elite junta has diminished. With the advent of the internet, it is possible for any person to acquire proficiency in a chosen field with little to no supervision at a click of a button [1, 2, 3].

This unrestricted access to knowledge has led to major shifts not only in classroom dynamics, but also in the way a learner is able to acquire proficiency in a given subject. This trend has been recognized and has led to reputed institutions/universities around the world to offer specifically catered online programs and degrees either on their own or through third party websites [4]. In addition, the pandemic situation has also initiated the shift from a traditional classroom environment to an online setting at a rate faster than expected. These changes in the dynamics of teaching and learning have required mainstream educators to adapt to the changing times and tackle problems associated with it such as student mentality, approach to subject [5]. Along with the undeniable advantages of online education such as enhanced teaching and learning, Globalization, no geographical limitations among others; there are certain major negative impacts to it such as declining writing skills, increasing plagiarism, and lack of focus [6]. More often than not, majority of the issues arise due to inability of the teacher to fully harness the capabilities of the online teaching platform.

The pandemic situation in India was severe and the uncertain future in regards to offline classes has forced the educators and learners to adapt to the online platform [7]. Though the online platform has some advantages to its credit such as freedom to learn from home, ability to use ICT tools like augmented reality, PowerPoint, polls, and pop quizzes which make classroom discourse engaging for the learner, a major factor for concern is the lack of social interaction with the teacher and inability to encourage active classroom participation. Furthermore, students from poor socio-economic backgrounds may find the use of such online tools intimidating and be a major stumbling block for first time users. In addition, the added pressure from peers, family and family economic situations can further create an unsuitable environment for active student participation [8].

In this paper, we discuss the challenges posed and provide possible alternatives that can be employed in offline/online classroom settings for effective and relatable course delivery. Furthermore, the teaching techniques discussed here can be used as per discretion of the educator either in conjunction or as standalone exercises as part of classroom engagement comprising of students with different learning styles and socio-economic backgrounds [9].

II. DISCUSSION

A. Understanding the millennial (Gen X, Y, Z & α) student:

As compared to all the previous generations, there is no doubt the millennial students are the most diverse and largest generation to attend higher education [10, 11]. Their personalities, preference to education, thought processes as a whole makes it a challenge to engage them in a regular classroom setting. Common traits exhibited by millennials are lack of professionalism, sense of entitlement, need for recognition, over-reliance on technology, and unrealistic expectations. In addition, a majority of such students expect to be handed either readymade lecture notes or a "know-how" guide for preparing for their exams. A very dominant trait in a millennial student is his/her reluctance to spend time on understanding, doing the tasks and expect success with minimal to no effort.

Based on the Howe and Strauss's research [12], the characteristic traits in a millennial can be categorized as

follows

1. Millennials feel they are special [13]
2. Millennials are sheltered
3. Millennials are team oriented
4. Millennials are confident
5. Millennials are pressured
6. Millennials have strong aspiration [14]
7. Millennials are conventional [15]

In addition, Millennials are extremely comfortable with the use of technology as compared to previous generations, have short attention span, respond well to communication and are ready to accept change. As the focus of higher education teaching is shifting from a teacher to a more student-centric approach. It is important for the educators to exploit the best features in the millennial student in order to deliver effective and relatable content.

Furthermore, as more of the teaching is shifting to the digital media due to the pandemic, the content delivered by the teacher can only be effective if the student is also made an active participant in the learning process through a combination of a variety of instructional delivery methods. The first step in doing so is by understanding the needs of the student and tailoring the teaching process accordingly. In this study we have focused on two aspects of the teaching learning process such as blended learning and active learning to foster engagement of students while learning.

B. Brain based learning

The primary avenues of learning available for a student are: in-class lectures, individual learning, and peer-based learning. The regular discourse during class provides the student with information with regards to its history, structure, basics and application. This is a crucial step in the learning process and paramount attention has to be paid to communication in-class between the teacher and the student. Audio- visual tools used during the lecture only act as complementary aides; but the primary source of knowledge dissemination to the student is through regular lecture. The next step in the learning process is through individual exploration through assignments and homework; these not only gives the student an opportunity to further their knowledge by referring to other sources, but also reassess their in-class understanding and develop a personalized approach to the subject. The third step is through peer discussion, wherein students can discuss their experience in the subject either in a controlled classroom setting or in an informal conversation. The advantage here is that by sharing knowledge students get the unique opportunity to validate their learning strategies and sources. Also, students will be able to pick up the best learning techniques from their peers. Often major emphasis is given to the first two steps: in class and individual learning with the important peer-based learning neglected. In an online environment brain based learning can be implemented through the use of breakout sessions, assigning open book assignments (the solution to the assignment question can be found using the help of internet).

The human brain is geared to learn in small chunks, respond well to repetition, and focus on unusual new inputs. It has also been proven that emotions and social interactions are very crucial towards lifelong learning [16]. Scientific research has shown that neuron creation in brain is the primary basis for lifelong learning and memory. By making students active participants in learning the process of creating neurons is amplified. The research by Geoffrey and Renate, major proponents of brain-based learning clearly devised steps that promote lifelong learning and memory. They said [17],

1. Learners must be immersed in complex interactive experiences
2. Alertness of learners' mind is achieved through challenges.
3. A problem must be given with all possible ways to solve in order to promote insight

Based on the above information, we can formulate a strategy that encourages the learner from being a passive spectator in the class to an active stakeholder. Traditional teaching practices have found to be missing a point or two in addressing few of the millennial's needs. It is therefore important to develop a new strategy that is a blend of best practices from brain based learning and use of technology in teaching.

C. Blended Learning

Knowledge combined with information communication technology (ICT) in education has steadily gained popularity owing to its contribution in promoting the necessary soft skills in a student in addition to learning, achievement, and enhancement in lifelong skill [18]. Further it has been noticed that usage of ICT also helps the instructors to share their best practices, which leads to the improvement in the quality of education imparted and efficiency in student engagement [19, 20]. In a traditional classroom setting, the main emphasis is on the teacher and on the medium of instruction (talk, chalk). Students are typically relegated to writing in-class notes and understand the concepts. This unidirectional approach often leads to some of the students copying the contents from the board without as much as giving a second thought. This often leads to distraction and the student has to catch up during the course of the lecture. In teacher centric approach there is very little opportunity for the student to interact about the course lecture with the teacher/peers. One way to address this is by incorporating Flipped classroom techniques, wherein the roles of the teacher and students are fluid and the focus shifts predominantly from the teacher to the learner [21, 22]. The four attributes of "FLIP" are Flexible (Environment), Learning (Culture), Intentional (Content) and Professional (Educator), which play a crucial role in engaging the students better in the class.

The role of a teacher in a flipped classroom setting is much more demanding than in a regular setting. A large part of the class goes towards organizing and facilitating proper

discussion between students, care has to be taken to keep the discussion within the context of discussions. According to research by Mazur et.al, an instructor's role is to facilitate and channel a student's critical thinking abilities [23]. Designing hybrid classes comprising of flipped and traditional methods is popularly known as blended learning. In blended learning, educators play a crucial role in its implementation and success as a lecturer and as a facilitator. Educators have to actively influence, guide and make students participate to create a student centric learning environment [24]. Some of the best practices of blended learning are elucidated below.

Digital study materials: Handwritten or printed course material prepared by the educators must be compiled from various sources. This gives the learner the advantage of gaining information in addition to the contents of the regular curriculum. This helps the students in gaining extra information for research and also to further their interest in that particular course. A major advantage of this method is that the reading material can be downloaded and used offline at the students' convenience. This gives the learner additional flexibility and teaches them to hone their skill in making their own notes.

Video study material: Research has shown visualization has a positive influence on a learner's memory retention and understanding of the subject. A recorded video lecture provides slow learning students with an opportunity to revisit the lecture and familiarize themselves with complex sections of the lecture. Further, it also aids students who have missed the lecture to catch up with the rest of the section. These recorded lectures also act as good review guides for students while prepping for assessment tests and exams. Selected YouTube videos can also be considered as supplemental lectures in addition to the regular discourse. Video lectures can also be used as an aid for experiments as part of lab component. It can be helpful for students to prepare for practice sessions and make them think regarding the conduction of the experiment. This in turn would get the students to ask queries related to the experiment prior to the practice session.

Games: Games have been an integral part of childhood and appeal to demographic of any age group. The purpose behind incorporating games as part of learning is to boost student engagement and enhance high-level critical thinking. Jeopardylabs.com is one such website that allows instructors to design interesting games for a few topics of the chosen course. The games can be varied in nature for example, in the game answers will be displayed and students will be asked to formulate the question; which is a drastic shift from the traditional way, where the educator asks the question always. It also helps to foster collaborative and communication skills [25].

Quiklrn: Taking the advantage of smartphone usage, an android based app designed exclusively for students and educators. This app developed by Quiklrn Private Limited [26], provides a unique platform wherein, the study material can be customized according to learner's convenience. In addition to many relevant features this app when coupled with Google meet can be used to conduct proctored online tests/exams, by providing appropriate guidelines to the students.

Practice session: Skill enhancement is facilitated through practice. It helps supplement theory learned in class and from textbooks. Theory and practice sessions go hand in hand in developing deep and lifelong learning. During lab sessions experiential learning experiments can be included to increase their creative, confidence and skill in conducting experiments. During these experiential learning-based experiments, students perform the experiments with little to no monitoring and are encouraged to research the experiment on their own.

Animated study material: PowerPoint presentations are used as audio-visual aids by the educators to explain the concepts better in class. While listening to the educator's explanation, it's cumbersome for the students to draw/note down the contents displayed in the presentation while keeping pace with the lecture. Moreover, some of the concepts are better understood with animation and visualization [27]. The presentations can be used as tools to refresh student's memory as they read the material at a later point.

Experiential learning: Lifelong skill and team experience is very much essential in professional life and it is crucial to nurture this habit in students from a very early stage. By the use of EL techniques, students are made to work as a team to understand the principle, methodology and solve problems. This results in better communication skills, adaptability, understanding to work in multi-disciplinary environment, etc. In addition, students become better at coming up with innovative ideas and applying out of the solutions.

Exposure to research: It is crucial for a teacher to properly indoctrinate the relevance of the course in terms of current context. This can be achieved by making the students aware of the current technological advances in the subject. Regular visits to an R & D/Industrial facility either on or off campus is the first step in piquing the interest of the students. The fruitful interaction with domain experts and exposure to the state-of-the-art technology will definitely be a lifelong learning experience. Research is crucial in imparting lifelong learning among students. ICT has taken priority focus in 21st century skills and is paramount in addressing sustainability development goals.

Online Courses: Many of the accreditation bodies/ organizations around the world have introduced online courses in their accreditation criteria like MOOC, NPTEL, SWAYAM and COURSERA, etc. Related to their courses students can avail this opportunity to further their knowledge. This opportunity can also be availed by faculty to improve on their course content and learn newer teaching techniques. The advantage of using this technique is that the necessary academic requirements are fulfilled, and learning happens in a flexible environment with accountability.

D. Active Learning

The 21st century society needs individuals who are adaptable, innovative, and proactive to tackle societal challenges. The 'knowing of knowledge' is just not enough to

be successful in complex issues, evolution is key. Enhancement of life-long learning and potential success can be achieved by initiating early training of the learners in their respective domains. These skills are an integral part of the NEP 2020 curriculum.

In the learning space, active learning promotes students to transition from being passive to active. Students are constantly engaged in problem solving, question and answer discussion, question formulation discussion/ brainstorming, narration, explanation, during the class. The outcomes of employing active learning techniques are enhanced student participation, improved memory retention, longer attention span, student ownership of their learning, exciting classroom environment, innovative thinking, and reduced lecturing of course material.

In addition, active learning techniques such as concept mapping, minute paper, Think Pair Sharing, real life application-based learning, simulation, modeling and group discussion can also be employed for active student participation. Through these activities students develop a sense of ownership and accountability towards their learning; which in turn enhances their creativity, critical thinking skills and team spirit. Use of activities like polls, activity, jokes, puzzles, etc. interspersed with regular lecture can help maintain students focus on the discussion. Prior knowledge of students likes/dislikes and disposition can be used as the foundation to design these activities. Relationship of the course content with existing knowledge can be done through active learning strategies.

According to research the average attention span of a student in class is approximately 15 minutes. This information can be used to design lectures which are fifteen minutes each and allow students to process the information in the brain actively. Active learning strategies can be for classes of any strength and backgrounds. It can be done either as an individual or a group exercise. A generic list of activities with time limits is given in Table-1 as reference.

TABLE I
Time requirement for different activities

Under 6 min	6-10 min	10-20 min
Class Polls	Verbal Quizzes	TAPPS (ThinkAloudPair Problem-Solving)
Fish Bowl Minute Papers	Problem Solving Exercise	Concept Tests
Think, Pair & Share	Critical Thinking Exercises Role play	Case Studies
Designing Questions	Brainstorming – Reverse Brainstorming	Concept Map

Though the techniques mentioned are old, the novelty is in the implementation by the teacher depending on the course and curriculum. After the content is delivered the educator must summarize the concept, ask questions related to the concept, its application, student's their opinion. The active learning techniques mentioned in Table-1 are discussed below in detail.

Polls: It is the easiest and most effective strategy to get immediate feedback from the students. Various apps/software to conduct them like ppt, pollseverywhere, mentimeter, etc. can be used to conduct polls at any given point during the lecture. There are many case studies available in literature proving the efficacy of polling during lecture. An analysis of a student's metacognitive skill has been [28] using a polling mechanism.

Think Pair Share: For a given topic students will turn to their neighbors for discussion and then present their combined ideas to the entire class. This is an effective strategy for students who are inherently shy and face problems communicating in large groups. The significance of think-pair-share (TPS) technique as a measure of state anxiety and social evaluative concern is given in literature [29].

Minute paper: Students are allowed to use a small paper to give their feedback in one minute at the end of class. Minute paper has lots of benefits for students and teachers [30]. The originality of minute paper is derived from its multi-layered qualitative approach, which provides a deeper insight into the direct and indirect mechanisms of learning.

Fish bowl: This can be done at the beginning or end of class. In which students will be writing one concept for which they need clarification. The paper can be dropped in a box without a name. The educator then picks up a random paper from the bowl and clarifies the concept. This is very helpful for students, who are hesitant to ask questions or are introvert by nature. This could also be considered as an extension of minute paper activity.

Brainstorming: Brainstorming is a simple yet effective technique in which all the learners of the class can participate and contribute. The educator asks open ended questions related to a topic and facilitates healthy discussions/debates to encourage out of the box thinking. During the discussion, students discuss and share their perspective in front of the class which is further put up for iteration among other groups. It is very helpful in solving real world problems.

Games: As discussed in previous section games are always fun and boost active participation among students. A big cause of concern is the veracity and seriousness of such games in higher education. The need for developing a suitable rationale is highlighted and requires relevant considerations.

Case studies: Case studies are real-life experiences or problems that help students to make a connection between the theory concept and a persisting real-world situation. Educators can design or collect case studies that can relate to the topics of the curriculum. In literature many examples of case studies are given. One interesting example of a system based on ammonia fuel cells is reported.

Designing questions: In this exercise students are required to frame questions and write what the answer is they are expecting for the questions. This subtle role reversal will give the students valuable insight into what is expected while setting a question paper and how to answer the questions. Further, a selection of the questions set by the students can be used as a question bank of sorts for future reference.

Problem-based Learning (PBL): In PBL, the primary focus of imparting education is through problem solving and team-based learning. Study on strategy to implement PBL has revealed that it is an ideal evidence-based option to fill the skill gaps to foster critical thinking in generation Z [31]. An instructor can conduct PBL for a day, as an overnight challenge or more than a week. The point of this exercise is to use the concept of PBL as part of regular course implementation.

Role play: Role playing is a deliberate acting out of a problem statement in a classroom. This helps students see reality through the eyes of the society. Students not only get a clear understanding of the theory concepts, but also give them an insight into the modalities of practical application and its effect on society. The effect of role playing as a tool of preconditioning in students of macroeconomics and informatics is highlighted as a select case study [32]. This can be incorporated in an online setting by using breakout sessions.

Verbal quiz: The class can be split into many groups of size 3 to 5 members of diverse performance criteria with regular quiz rules. In this way students can learn from each other and inculcate a sense of friendly competitive spirit in them. Students feel they achieved more in learning compared when they did the task alone.

Concept mapping: Concept mapping is a systematic methodology that recognizes participants' expertise through their experiences. This approach uniquely blends quantitative and qualitative techniques to create illustrative, structured conceptualizations for a diverse group of students [33]. Concept mapping can be used as an effective tool for research and evaluative strategies. Research has reported better retention and deep learning in students through concept mapping.

III. CONCLUSION

21st century education is evolving with the technology and the onus is on the educator to adapt to the changing times to make course content palatable to the millennial students. Traditional teaching methods are no longer sufficient and require an upgrade in terms of combining them with other teaching techniques. In this paper we discuss the various techniques that can be employed by a teacher in-class to make the course content interesting, relevant and more importantly accessible to the students. Furthermore, these techniques also help the educator to address students of diverse backgrounds equally and transform them from passive listeners to active stakeholders. These techniques also promote critical thinking, deep learning and creativity among students. The need of the hour is that education is the key to developing sources of creativity. As part of active learning strategies, the implementation of techniques mentioned in this paper is based on the convenience of the instructor. The techniques can be applied with respect to the feasibility of time and curriculum. By combining the right blend of active learning strategies and blended learning techniques instructors can improve course delivery and inculcate lifelong learning in students.

IV. ACKNOWLEDGMENTS

The authors would like to thank Dr. Subramanya KN, principal of RV College of Engineering for giving them the opportunity to be a part of student-centered teaching workshop conducted by IUCEE. The authors are also highly indebted to their respective department heads and colleagues for their encouragement and support.

REFERENCES

1. Curtis J. Bonk, (2009), The World is Open: How Web Technology Is Revolutionizing Education, EdMedia+ Innovative Learning. ISBN 978-1-880094-73-0
2. Jon Jonasson, (2006), The Internet - the Educational Medium of Today, Educational Media international. Volume 34, 1997 - Issue 2
3. K. Ratheeswari, (2018), Information Communication Technology in Education, Journal of Applied and Advanced Research, 2018, S45L S47
4. A. Frank Mayadas, John Bourne, Paul Bacsich, (2009), Online Education Today, Science, Vol 323, Issue 5910, pp. 85-89
5. Parker, K., Lenhart, A., & Moore, K. (2011). The digital revolution and higher education: College presidents, public differ on value of online learning. *Washington D.C.: Pew Research Center.*
6. Raja, R., & Nagasubramani, P. C. (2018). Impact of Modern Technology in Education. *Journal of Applied and Advanced Research*, 3(1), 33-35.
7. Dhawan S. (2020). Online learning: A panacea in the time of COVID-19 crisis. *Journal of Educational Technology Systems*, 49(1):5-22.
8. Yadav, A. K. (2021). Impact of Online Teaching on Students' Education and Health in India during the Pandemic of COVID-19. *Coronaviruses,* 2(4):516-520.
9. Caine, R.N. & Caine, G. (1997). *Education on the Edge of Possibility*. Association for Supervision & Curriculum.
10. Monaco, M. & Martin, M. (2007). The Millenial Student: A New generation of Learners. *Athletic Training Education Journal,* 2:42-46.
11. Strauss, W., & Howe, N. (1991). *Generations: The history of America's future, 1584 to 2069*. New York, NY: William Morrow & Company, Inc.
12. Howe, N., & Strauss W. (1993). *Millennials Rising: The Next Greatest Generation.* New York: Vintage Books
13. Lowery, J. W. (2001). The millennials come to campus: John Lowery talks with William Strauss. *About Campus,* 6:7-12
14. Coomes, M., DeBard, R. (2004). *Serving the Millennial Generation*. San Francisco: Jossey-Bass. 2004
15. Chickering, A. W. & Gamson, Z.F. (1987). Seven

Principles for Good Practice in Undergraduate Education. *AAHE Bulletin,* 39:3-7.
16. Peña-López, I. (2009) *Guide to Measuring Information and Communication Technologies (ICT) in Education*; UNESCO Institute for Statistics: Montreal, QC, Canada.
17. Caine, R.N. & Caine, G. (1994). *Making Connections: Teaching & Human Brain*, Revised edition. Addison-Wesley.
18. Goktas, Y., Yildirim, S., & Yildirim, Z. (2009). Main barriers and possible enablers of ICTs integration into pre-service teacher education programs. *Educational Technology & Society*, 12(1): 193-204.
19. Deslauriers, L., McCarty, L. S., Miller, K., Callaghan, K., & Kestina, G. (2019). Measuring actual learning versus feeling of learning in response to being actively engaged in the classroom. *Proceedings of the National Academy of Sciences*, 116(39): 19251–19257.
20. Perkins, D. N. (1984). Creativity by design. *Educ. Leadership*, 42:18–25.
21. Yelamarthi, K., & Drake, E. (2015) A flipped first-year digital circuits course for engineering and technology students. *IEEE Transactions on Education,* 58(3):179–186.
22. Mason, G. S., Shuman, T. R., & Cook, K. E. (2013) Comparing the effectiveness of an inverted classroom to a traditional classroom in an upper-division engineering course. *IEEE Transactions on Education,* 56 (4):430–435.
23. Crouch, C. H., & Mazur, E. (2001). Peer Instruction: Ten years of experience and results. *American Journal ofPhysics*, *69*(9), 970–977.
24. Swarna M Patra, Ganesh C L, K N Subramanya. (2020). Implementation of outcome-based education focusing on curricula, methodologies and outcome. ISSN:2642-021X, 3(2), 289.
25. Gómez, R. L. & Suárez, A.M. (2021) Gaming to succeed in college: Protocol for a scoping review of quantitative studies on the design and use of serious games for enhancing teaching and learning in higher education. *International Journal of Educational Research Open*, 2–2:100021.
26. Quiklrn: Quiklrn Private Limited, Version 1.0.8, 2017.
27. Fellah, A., & Bandi, A. (2018). The Essence of Recursion: Reduction, Delegation, and Visualization. *Journal of Computing Sciences in Colleges*, *33*(5), 115–123.
28. Molin, F., Haelermans, C., Cabus, S., Groot, W. (2020). The effect of feedback on metacognition - A randomized experiment using polling technology. *Computers & Education*, 152:103885.
29. Mundelsee, L., & Jurkowski, S. (2021). Think and pair before share: Effects of collaboration on students' in-class participation. *Learning and Individual Differences,* 88:102015.
30. Damian Whittard, Reflections on the one-minute paper, International Review of Economics Education, Volume 20, 2015, Pages 1-12, ISSN 1477-3880,
31. Seibert, S. A. (2021) Problem-based learning: A strategy to foster generation Z's critical thinking and perseverance. *Teaching and Learning in Nursing*, 16(1):85-88.
32. Kucharčíková, A., Ďurišová, M., Tokarčíková, E. (2015). The Role Plays Implementation in Teaching Macroeconomics. *Procedia - Social and Behavioral Sciences,*174:2489-2496.
33. Dare, L. & Nowicki, E. (2019). Engaging children and youth in research and evaluation using group concept mapping, *Evaluation and Program Planning*, 76:101680.