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Literature Review

A review on modern teaching and learning techniques in medical education

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Abstract: Education is an ever-evolving and active process that requires periodic refinement. The absence of innovative teaching techniques in academics leaves medical curricula inadequate to take significant strides towards the future. The objective of this review is to define and evaluate alternative methods of teaching and learning that can supplement or serve as alternatives to didactic lectures. These methods aim to promote active student involvement and expedite a smooth flow of information. A literature review was conducted using PubMed, OVID and EBSCO, utilizing keywords such as "learning," "didactic lectures," "alternative techniques of learning," "modern learning techniques," and "medical education." Database searches identified 300 studies, with 250 selected for further screening based on inclusion and exclusion criteria. Articles were surveyed for relevance and significance to our study objectives, encompassing both qualitative and quantitative studies. Various modern learning methodologies were identified, including Case-Based Learning, Evidence-Based Medicine, Problem-Based Learning, Simulation-Based Learning, e-learning, Peer-Assisted Learning, Observational Learning, Flipped Classroom, and Team-Based Learning. These methods address individual learning differences, allowing students to broaden their thinking and professional knowledge. Early introduction of integrative approaches develops student competency and leadership, preparing them for a seamless transition into clinical practice. This study emphasizes the significance and challenges of modern learning systems. Given technological advancements and the broader implications of medical information, students require innovative skills through inter-professional learning. It is imperative to introduce and implement flexible medical curricula that accommodate distinct modern teaching methodologies to address the evolving needs of medical education.

Keywords: case-based learning, problem-based learning; evidence-based learning; modern teaching techniques

1. Introduction

The educators are exclusively vital part of our society, but teaching can be a demanding and stressful job in this era. Particularly when working with medical students, it can be hard to retain focus, encourage active participation mainly ratings or scores in internal and external exams. In addition, teaching medical students can have its own challenges – it can be difficult for adult learners to absorb new terminologies, new pattern of teaching, exam taking techniques and change old pattern of learning.

Over the years we used Didactic lectures and book-based teaching, with repetition and examinations for strengthening as well as newer teaching methods such as problem-based learning and some case-based seminars. (Williams, 2005; Nilson, 2010).

In 1989, Walton and Matthews addressed the importance of problem-based learning in a symposium at the World Federation of Medical Education, with the determination to inform educators in undergraduate, postgraduate and continuing medical education of this new

form of education. The concept was measured to be a very treasured educational approach by the World Health Organization (WHO) (Walton ,1989).

The Chang et al. reported that problem-based learning improved student enthusiasm and gratification, though, there was no considerable evidence of improved learning. The authors concluded that the combination of both traditional and problem-based learning would probably provide the most exceptional training for undergraduate surgical students (Chang, 1995).

One thing that may help you deal with some of these challenges is learning about the different teaching methods available. You don't need to pick one method and stick to it, but you may find that certain methods and styles are perfect for different learning environments. With the right teaching methods, educators can create an enjoyable and productive classroom experience for students where they can learn important academic and social skills to last a lifetime. There are many frameworks that the educator could use to support students with different interests, abilities and learning styles. If you're the educator or professional in the medical education field, you might benefit from learning about new instructive strategies in the field to maximize your students' chances of success in your classroom.

Main objective of this article is to discuss and analyze different teaching-learning methods in contemporary medical education.

2. Materials and Methods

A thorough literature searches of Pub Med, Medline, Research gate and Google Scholar for data sources mentioning the modern teaching and learning techniques in Medical education to date is included in the study. The various teaching methods were investigated through these sources. The key words used to search the appropriate articles were "Medical education", "Learning techniques"," "Team-based learning" or "Problem-based learning", "Case-based learning", "Evidence-based learning" and "Innovative learning in medical education" (Williams, 2005; Nilson , 2010).

Descriptive data of each teaching technique and its implementation were compiled from published data of sample sizes greater than 150. These articles have then further scrutinized by Inclusion and Exclusion criteria. Inclusion criteria was set to include studies that were peer-reviewed, open-access, published from 2000 to 2023, articles should be in English. Exclusion criteria was set as literature in non-english languages, little or no focus on educational methodologies, studies that did not include at least one of the key search terminology.

3. Results

The search indicated 35 articles which were narrowed down by title and abstract relatedness. 23 articles entered the second phase of the study and after reviewing their full text, finally, 10 articles which were explicitly and implicitly reported the underpinning learning theories remained. These modern techniques of teaching and learning are well validated and commonly being employed in most of the medical school. We carefully reviewed them to analyze their perceived and proven effectiveness, and challenges in introduction and implementation. Similarly, we also provided recommendations to overcome these limitations/challenges (Archana, 2023).

- Case-based learning (CBL)
- Evidence-based medicine (EBM)
- Problem-based learning (PBL)
- Simulation-based learning (SBL)
- Social media and video lectures (e-learning)
- Peer tutoring learning
- Observational learning
- Team-based learning
- Flipped classroom
- Virtual and augmented reality learning
- Gamification learning

4. Review of Literature

Table 1 shows the literature review on multidisciplinary learning techniques with their key research findings, research types and most important purpose of the study.

Table 1. The literature review on multidisciplinary learning techniques

Authors	Research type	Research purpose	Findings
Banur Raju Archana, Sampath Sangeetha 2023.	A descriptive, online questionnaire-based survey	To evaluate the effectiveness, advantages and disadvantages of e-learning classes conducted for medical students during the COVID-19 pandemic	Implementation of distance e-learning in medical education is challenging, especially in developing countries like India. E-learning reported increasing knowledge, easy access, better environment. But lack of clinical skills, technical problems, mental health are major barriers to e-learning in medical education. Although e-learning is the best alternative in the present scenario, it cannot replace traditional teaching method. It can be used along with regular face-to-face learning to make teaching more effective.
Patison Palee, Noppon Wongta 2020.	Cleft Island online game which is developed and evaluate a serious game to deliver knowledge about the cleft lip with or without cleft palate .	To develop and evaluate the effectiveness of serious game to deliver knowledge	Improving students' knowledge on performing cleft lip with or without cleft palate surgeries.
Magnus Sundbom, Per Hellstrom 2021.	It's a retrospective study, compares student-ratings from the problem-based learning era to a new hybrid concept.	It's a study to evaluate the problem-based learning shall be supplanted with the new concept, consisting of a theory week with traditional lectures and case seminars.	The study group involved 621 students (57% females, total response rate of 52%). Scores for lectures (4.9 vs.3.8) and teaching stimulation and feedback (4.6 vs 3.6, and 3.7 vs 3.4, respectively), and to what extent the contents reflected learning goals (5.2 vs 4.3, $p<0.05$ for all) were instantly improved, which also prevailed in the following semesters. At the end of the study period, a significant improvement in case seminars (4.8 vs 4.3) and practical training (4.9 vs 3.8, $p<0.05$ for both) was seen. The new learning concept resulted in both improved student-ratings and more satisfied teachers. We believe that the hybrid concept, coalescing lectures and case-seminars, assisted learning and improved the learning climate. The subsequent continuous practical training also received improved score.
Sneha Ambwani, Bhavisha Vegada, Rimple Sidhu , 2017.	This study was undertaken to compare the integrated teaching method with the didactic method for the learning ability and clinical applicability of the basic sciences.	The study was conducted into two stages. In the first stage, conventional didactic lectures on hypertension (HT) were delivered to one group and multidisciplinary integrated teaching to another group. For the second stage, diabetes mellitus groups	There was no significant difference of MCQ score between integrated HT, didactic HT, and integrated diabetes group. However, the score obtained in didactic diabetes was significantly more (P = 0.00) than other groups. Majority of the students favored integrated teaching for clinical application of basic science and learning of the skill for the future clinical practice. Faculties considered integrated method as a useful method and suggested frequent use of this method.

were swapped.

4.1 Case based learning (CBL)

Case-based learning is a student-centered learning approach where students read and discuss complex situations and relate their knowledge to each situation. Students generally examine the case together as a team and address the problems within the realistic scenario to develop a reasonable conclusion. By learning how to apply your knowledge to real or hypothetical scenarios, you can better develop your critical thinking and analytical skills to become more prepared for the workplace. In this article, we discuss what case-based learning is and how you can use it to apply a theory or a concept to a variety of situations.

Mentors frequently use CBL for students that are interested in medicine. Both PreMed and Med schools use CBL to give students the chance to apply what they're learning in the classroom to complex issues and help solve problems. There are a few types of case studies schools use to lead discussions and encourage students to evaluate problems.

Exploratory case study. These case studies typically focus on real scenarios and identify key issues prior to a larger investigation. They help to identify potential problems for additional research and are common in the political science field.

Descriptive case study. Case studies that are descriptive tell a story about a situation and may even have quantifiable results and a conclusion. These studies are common in the business, medical or law fields and may collect research from different sources and even different time periods.

Intrinsic case study. These case studies typically involve a unique subject, like a patient or a brand, and focus on understanding that subject and its situation better. It explores how the subject's environment affects it and is common in the medical or business fields.

Explanatory case study. Case studies that are explanatory describe an event or series of events with the aim of discovering the cause of the event, and a variety of fields use them (Figure 1).

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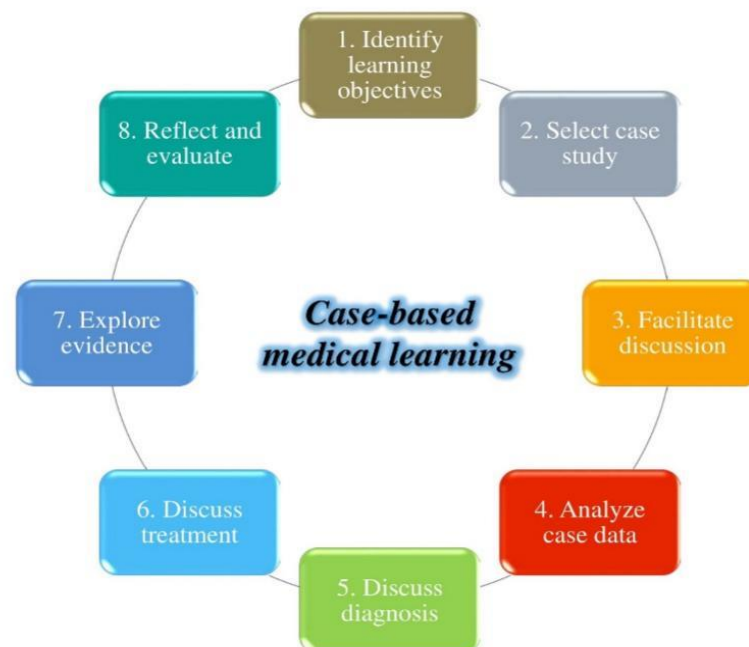
Figure 1. Pattern of teaching in case based learning.

4.1.1 Benefits of case based learning

It helps in application of Knowledge into the Real-World Context. Students are encouraged to think critically, analyze information, and make informed decisions as they would in

professional settings. It challenges students to identify problems, break them down into components, and develop effective solutions. Learners gain experience in making decisions based on available information and considering potential outcomes. Fostering a student-centered learning environment where individuals actively engage with the material. Engaging in real-life scenarios enhances long-term retention of knowledge as students connect theoretical concepts to practical applications. CBL often involves presenting findings or solutions, improving students' ability to communicate effectively, both in writing and verbally. Even exposes learners to diverse scenarios, fostering adaptability and preparing them for a range of challenges in their future professions. Dealing with evolving cases helps students develop resilience and the ability to adapt to change as well as encourages self-directed learning as students actively seek information and resources to address the challenges presented in the cases (Mostert et al, 2007).

4.1.2 Challenges of design and implementation of case based learning

It's due to uncertainty about the right learning needs, depth of knowledge reached and choosing the right literature, time consuming, uncommitted study groups, too much responsibility, and concern about picking the wrong learning needs given that facilitators do not direct. (Mostert et al, 2007).

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4.2 Evidence based medicine (EBM)

The concept of evidence-based practice has its origins in medicine. The term 'evidence-based' is now firmly rooted in the education lexicon. And with good reason; improvements in student learning and educational outcomes depend on the wider use of reliable evidence in classroom practice. However, much discussion of evidence-based teaching is based on a narrow definition that would benefit from a broader recognition of the role of evidence in teaching and learning (Figure 2).

Figure 2. States the evidence-based learning and its various methods.

However, everyday medical practice uses multiple forms of evidence. In addition to evidence from external research studies, medical practitioners gather and use evidence relating to patients' presenting conditions and symptoms – for example, by taking patient histories

and ordering diagnostic tests. Evidence of this kind is essential to informed decision making. So, too, is evidence about the subsequent effectiveness of a practitioner's decisions. Such evidence plays a crucial role in monitoring a patient's progress and evaluating the impact of treatments and interventions.

4.2.1 Benefits of evidence-based medicine

EBM focuses on applying evidence from well-conducted research studies, leading to more effective and evidence-supported clinical interventions. Patient care decisions informed by evidence tend to result in better outcomes and improved health for individuals. Medical practitioners can make informed decisions by considering the latest evidence, ensuring that interventions are aligned with the best available knowledge. It helps clinicians weigh the risks and benefits of different treatment options. Unnecessary tests or treatments that lack evidence of efficacy are avoided, reducing healthcare costs. Evidence-based practices emphasize standardized and proven approaches to patient care, reducing the likelihood of errors. Following established protocols and guidelines minimizes the risk of adverse events. Evidence-based learning ensures that healthcare decisions are grounded in ethical considerations. Balancing evidence, patient autonomy, and ethical principles guides clinicians in making ethically sound decisions. (Means et al 2009).

4.2.2 Challenges of design and implementation of evidence-based learning

Despite its indispensable role in modern education, incorporation of EBM has to be properly guided into the medical curriculum to achieve its objectives. It is to be seen precisely through the filter of personal training and experience as reflective learning is the best predictor of an optimal outcome. Insufficiency of knowledge and experience within the research field are some of the challenges. Students need to become acquainted with computers and have to undergo proper training on how to execute effective research using online databases. Similarly, statistical understanding can be challenging at times limiting its implementation.

4.3 Problem-based learning (PBL)

Problem-based learning (PBL) is a student-centered modern approach in which students learn about a subject by working in groups to solve an open-ended problem. This problem is what drives the motivation and the learning. In addition to course content, PBL can promote the development of critical thinking skills, problem-solving abilities, and communication skills. PBL can also be used to create assessment items. The main thread connecting these various uses is the real-world problem. Generally, delivery of PBL is done through small group tutorials in which instructions are conveyed by the teacher serving as an organizer. These lectures typically consist of various sessions, each dedicated to a problem in which a self-study period is allocated for searching and gathering information (Nilson ,2010). This constructs opportunities for students to follow and lay a stable foundation of self-directed learning. Medical students are required to co-construct their own connotation and understanding of reflective knowledge through social interaction rather than having pre-synthesized knowledge passively conveyed to them (Figure 3).
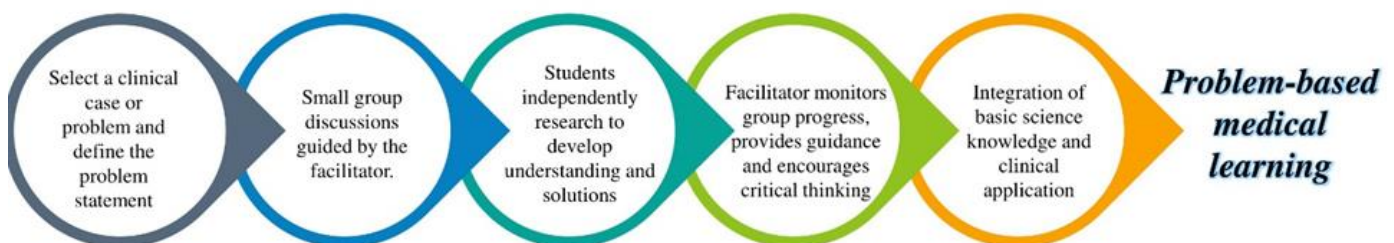

Figure 3. Stages of problem-based learning.

4.3.1 Why Use Problem-Based Learning?

Nilson (2010) lists the following learning outcomes that are associated with PBL. A well-designed PBL project provides students with the opportunity to develop skills related. PBL

promotes active learning, where students are actively engaged in solving problems rather than passively receiving information. Students take responsibility for their learning process, fostering a sense of ownership and motivation. And students analyze information, synthesize knowledge, and apply their understanding to solve complex problems. More so, students connect theoretical concepts to practical situations, preparing them for future challenges in their field. Collaborative activities during PBL enhance communication skills, teamwork, and the ability to express and defend ideas and Real-world problems capture students' attention and demonstrate the practical utility of academic knowledge. Because PBL involves active engagement and practical application, knowledge gained through this method tends to be retained for a longer duration hence this learning process is more memorable and meaningful. PBL prepares students to navigate situations with ambiguous or incomplete information as well as mirrors real-world scenarios where problem-solving often requires dealing with uncertainty. This provides a more comprehensive understanding of students' abilities beyond rote memorization.

4.4 Simulation-based learning (SBL)

Simulation learning is a strategy educator can use to not only teach course concepts, but to also provide students with opportunities to apply new skills, knowledge, and ideas in a practice setting that mirrors the real world.

Simulation is a generic term that refers to an artificial representation of a real world process to achieve educational goals through experiential learning. Simulation tools serve as an alternative to the real patient. Trainers can make mistakes and learn from them without the fear of distressing the patient.

Simulations let you develop key skills through trial and error in a safe, controlled setting before you move on to practice in real life. This kind of learning has been used for decades in industries such as aviation, healthcare, and the military, and is now being applied in more fields.

Clinical skills competencies including communication skills, history-taking, professional attitudes, awareness of ethical basis of healthcare, physical examination, procedural skills, clinical laboratory skills, diagnostic skills, therapeutic skills, resuscitation skills, critical thinking, clinical reasoning, problem solving, team-work, organization skills, management skills, and information technology skills should be part of the core undergraduate curriculum (Ledingham et al, 1998).

Recently, the inclusion of clinical skills training into the curricula of medical students has seen significant growth. There are many examples of curricular reform that include clinical skills training, the use of simulators, and the creation of clinical skills centers (Figure 4).

**Figure 4.** The importance of Simulation based learning in medical education.

4.4.1 Benefits of simulation learning

Simulation learning plays a crucial role in medical education by providing a safe and effective environment for learners to acquire and refine clinical skills, enhance decision-

making abilities, and foster collaborative and experiential learning. It provides a controlled and safe environment for learners to practice clinical skills without the risk associated with real patients. This is particularly crucial for high-stakes situations and rare clinical events. Learners can repeatedly practice and refine specific skills in a simulated setting, allowing for skill enhancement and mastery over time. This is especially important for procedures that require precision and expertise. Virtual reality can also be implicated into SBL to enhance learning standards and confidence in patient care (Chin et al.,2014). Many medical simulations involve teamwork, promoting effective communication and collaboration among healthcare professionals. This feedback loop is valuable for continuous improvement and learning from mistakes in a risk-free setting. Simulations can expose learners to stressful situations in a controlled manner, helping them develop resilience and coping strategies. This is particularly beneficial for preparing healthcare professionals for the challenges of real clinical practice. It fosters the innovation and continuous improvement in healthcare practices. Simulation allows for the efficient use of resources, as learners can practice without the need for real patients, costly equipment, or consumable supplies. This can contribute to cost savings and resource allocation in medical education (Lateef, 2010).

4.4.2 Challenges of design and implementation of simulation learning

Simulation-based learning often requires substantial resources, including high-fidelity mannequins, simulation labs, and advanced technology. The initial setup and ongoing maintenance costs can be significant barriers; Instructors need specialized training to facilitate simulation sessions effectively. Ensuring that faculty members are proficient in using simulation technology and capable of creating realistic scenarios is crucial. Limited physical space and time constraints in academic schedules can impede the implementation of simulation-based learning. Finding dedicated time for simulation activities and securing adequate space for simulation labs can be logistical challenges (Bigdeli, 2023).
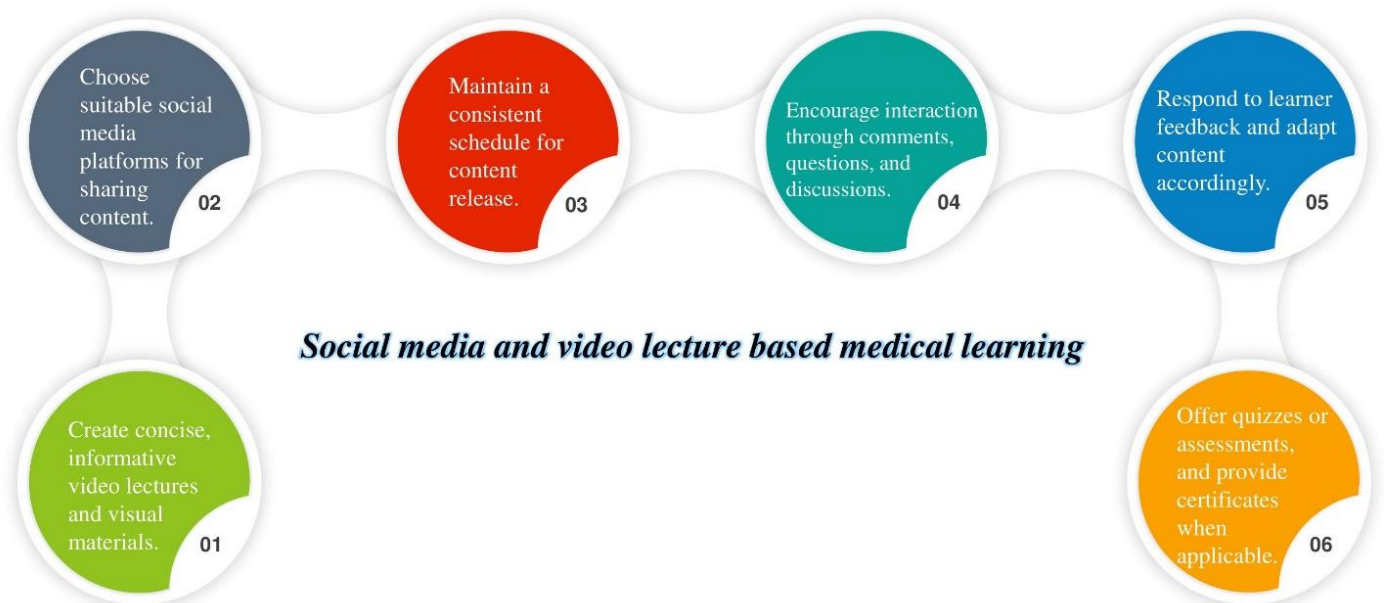
Figure 5. The necessary steps followed in e-Learning in medical education.

4.5 Social media and video lectures (e-learning)

Social media refers to the means of interactions among people in which they build, share, and/or exchange information and ideas in virtually in a global classroom. Although eLearning is based on formalized learning, it is provided through electronic devices such as computers, tablets and even cellular phones that are connected to the internet. Social media, when used in a responsible and age-appropriate way, can help children learn, think critically and build the skills they need for the future. Social media helps medical professionals to communicate,

share and learn, and offers opportunity for physicians to practice key 21st century skills they will use into the future. In this generation most of the classes will have videos, interactive sessions and also I human apps (Figure 5).

There are many platforms like You tube, LinkedIn, Research gate, educational bloggers who make use of technology into education. By providing training around social media and online professionalism, schools can efficiently educate students and prevent or reduce spaces in professionalism and breaches of confidentiality. Some Canadian medical schools have already begun to incorporate this within their curricula .(Rondon et , 2013).

A review Study on 42 articles, by Delungahawatta et al concluded that its varied in scope, cognitive domain, subject matter, design, quality and evaluation. The most prevalent methodologies involved multimedia platforms (33%) and case-based approaches (26%), were interactive (83%), asynchronous (71%) and accessible from home (83%). Twelve studies (29%) evaluated usability, all of which reported positive feedback. Competence in use of technology, high motivation and an open attitude were key characteristics of successful students and preceptors. (Delungahawatta et al 2022).

Medical education is evolving consistently to accommodate rapid changes in therapies and procedures. In today's technologically adept world, e-learning is an effective and convenient pedagogical approach for the teaching of undergraduate clinical medicine.

4.5.1 Benefits of e-learning

Several research and authors have provided sanctifications and benefits derived from the embracing of e-learning technology into faculties (Donald et al, 2003; Algahtani et al ,2011; Hameed et al 2008).

In a study performed on 560 medical students on their state of mind during online classes are majority of students (33%) reported no change, 29% were anxious, 26.1% were relaxed and 10.2% of students reported feeling depressed. The assessment of technology availability and usage among study participants proves that the majority of participants, 77.3% had very good IT skills, 55.7% of students used mobile phones as major media for online classes and 58.4% reported access to internet services were neutral, about 79.5% of students had previous experience with e-learning (Archana, 2023).

4.5.2 Challenges of design and implementation of e-learning

The e-learning is ineffective in increasing clinical skills and effective communication compared to regular face-to-face learning. Lack of clinical skills was reported as a major disadvantage of e-learning (93.2%), 64.8% reported a lack of concentration, 58% reported a lack of interaction and 54% reported more of theoretical as disadvantages of e-learning (Archana 2023).

4.6 Peer tutoring learning

Peer tutoring is a connection between people who are at the same career or classes, in which one student has more experience than the other in a particular domain/ course and can provide support as well as knowledge and skills transfer. Peer tutoring may be a one-on-one relationship or experienced in a group. At my school we do have this program in all the courses and its more effective especially for the students who are struggling with the particular topics or lectures. This type of teaching has helped most of their peers to overcome the struggle or understanding the contents more efficiently. It is an extensive system that assures to ensure strong bond between students and their peers, because they feel more comfortable with each other than the faculties and their overall performance were improved (Figure 6).

The 56 learners who completed the survey, the largest percentage (42/54, 77.8%) received tutoring in the 18-month Foundation (Pre-clinical) Phase of the SOM curriculum that precedes the United States Medical Licensing Exam (USMLE) Step 1. They emphasized the benefit of having tutors that were "kind," "encouraging," or "compassionate". The two groups varied slightly in the traits they chose to emphasize as being important in tutors and learners, with tutors focusing more on professional characteristics and the interpersonal aspects mentioned by both groups (Alexander, 2022).
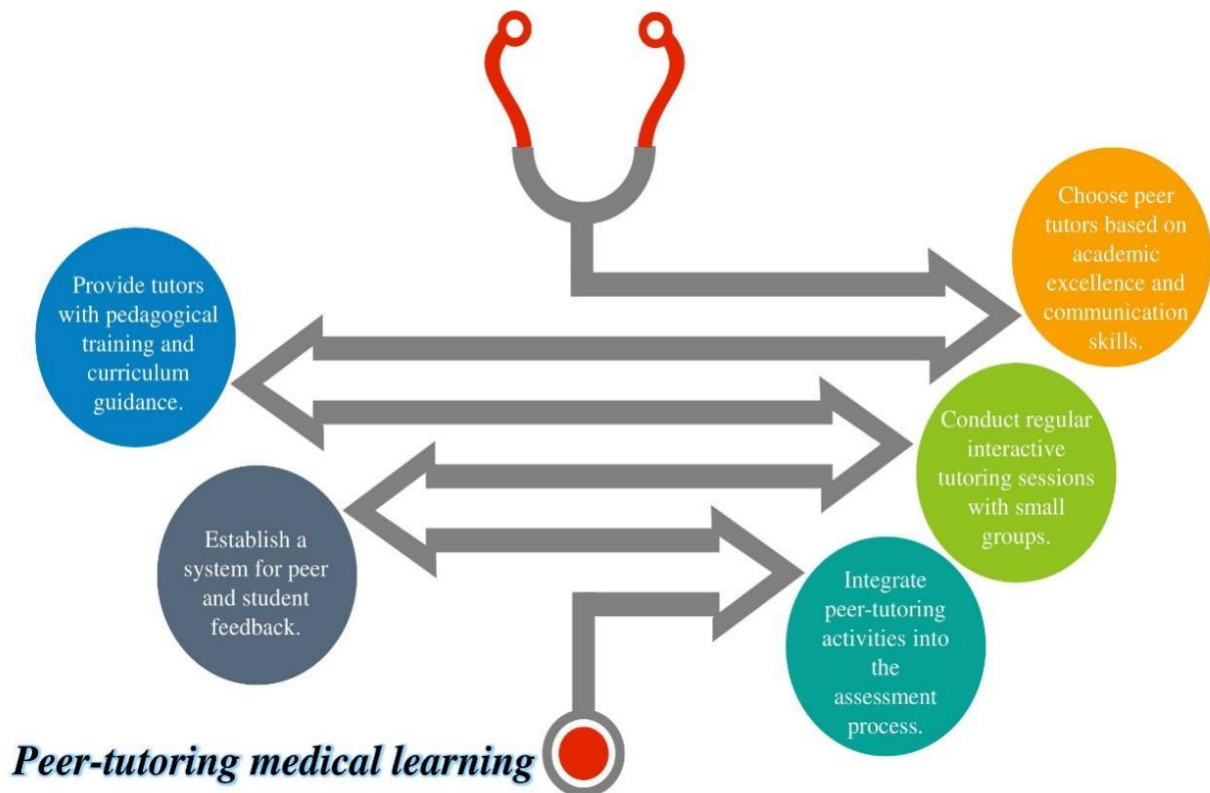
Figure 6. The wings of peer tutoring in medical education.

4.6.1 Benefits of Peer tutoring learning

It is bracing to watch students teaching each other. Peer tutors are challenged to use and hone their creativity and critical thinking skills to help tutees make sense of new material introduced by the professor. Students being tutored can ask questions to ensure understanding. For both students, reiteration aids retention. Peer tutoring increases motivation and improves the over-all academic performance of the class. If you are looking for a way to combat monotony, absence and truancy, peer tutoring is the answer.

4.6.2 Challenges of design and implementation of peer tutoring learning

Effective peer tutoring programs don't just happen; they require an investment of time and energy on the part of the school to launch and maintain. Researcher K.J. Topping stressed in a 1996 article in "Higher Education" that peer tutoring requires extensive training of peer tutors, careful matching of tutors to tutees, ongoing supervision and monitoring of progress. Associated costs can involve purchase of peer tutoring program materials and the expense of hiring staff to help teachers implement and manage peer tutoring initiatives. Without support, teachers will have less time for daily lesson planning. Resistance and Skepticism is also another disadvantage.
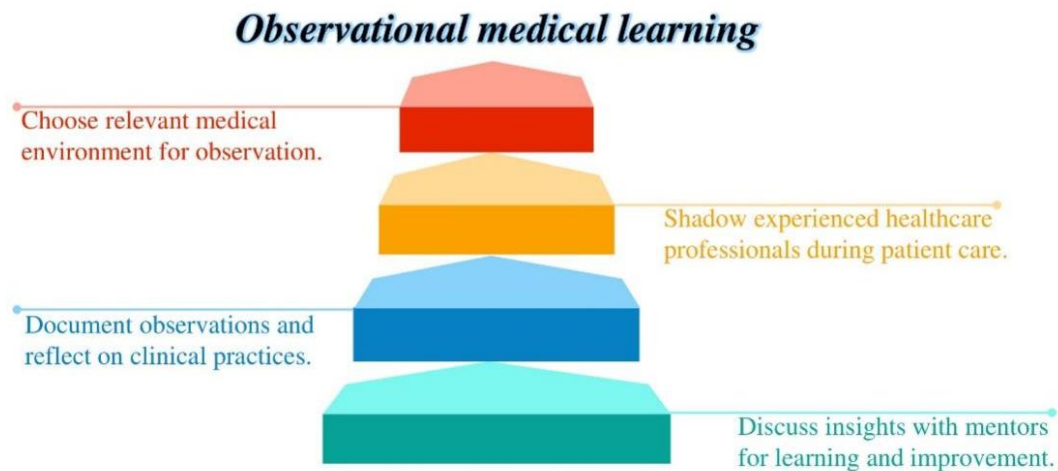
4.7 Observational learning

Observational learning is the gaining of behavior (knowledge and skills) that is learned through observing and replicating a model. Continuity is involved in the initial learning of the behavior and reinforcement fortifies the behavior once it is initially acquired.

In medical education motor skill development is mandatory as well as essential module of medicinal expertise and hence must be thought and practiced competently. There are many procedures like suture labs, CPR (Cardio pulmonary resuscitation), Nasogastric / orogastric tube insertions, and Orotracheal intubation. To have a hands on these procedures firstly observing them and then practicing the procedure is very important (Figure 7).

Additionally, observational learning could play an appropriate role during anesthesia training since the learner works in pairs most of the time (dyad practice). Some teaching methodologies should be taken into contemplation: an implicit engagement of the observer

motor system is required, immediate feedback seems to have an important effect, and a blend of observational and physical practice could be better than physical practice alone. In an atmosphere where effectiveness and efficacy are essential, observational learning seems to fit well (Cordovani and Cordovani, 2015).

Figure 7. The procedures followed in observational learning technique in medical education.

4.7.1 Benefits of observational learning

The observational method is easy, universal standard method since it usually does not require technical skills, and also high accuracy since the observer directly interacts with the observed. Another benefit is that very minimum cooperation is required. Observational learning is not only limited to manual demonstrations, video demos or animations also beneficial.

4.7.2 Challenges of design and implementation of observational learning

It's a time consuming process, main drawback is during the process observer and observed will lose interest in it after certain point of time. Ultimately accuracy and perfection of strategy will be effected. Hence we observational method and the other additional learning pattern is recommended (Gog et al 2009).

4.8 Team-based learning(TBL)

In this modern medical education curriculum most commonly used teaching pattern and popular enough is TBL. Universally, most of the healthcare faculties have embraced TBL in a variety of combinations, across varied settings and content areas. TBL provides an innovative approach to student-centered learning, supporting the flipped classroom method of healthcare education (Burgess et al 2015).

There are a number of resources and software suitable to deliver the various elements of TBL, including pre-readings/videos, IRAT, TRAT, and problem-solving activities. Careful consideration should be given to resource allocation that meets institutional priorities (Figure 8).

The steps in the TBL learning are as follows; Pre-class preparation- Individual readiness assurance test- Team readiness test- Feedback / clarification as soon as class- team discussion on clinical problem solving. There are 4 key components of TBL sessions are wisely formed or managed teams, regular and appropriate feedback (Burgess et al, 2020), problem solving and student peer evaluation.

4.8.1 Benefits of team-teaching

Team-teaching allows educators with diverse backgrounds, expertise, and teaching styles to come together. This diversity can provide students with a more comprehensive understanding of the subject matter. Collaborative teaching can lead to more interactive and dynamic classrooms. Multiple instructors can facilitate discussions, activities, and group work, promoting active student participation. They can learn from each other, share best practices, and enhance their teaching skills through ongoing collaboration. While team-teaching offers numerous benefits, successful implementation requires effective communication, coordination, and a

shared vision among educators. Regular communication, planning sessions, and a commitment to collaboration contribute to the overall success of team-teaching initiatives (Burgess et al 2020).
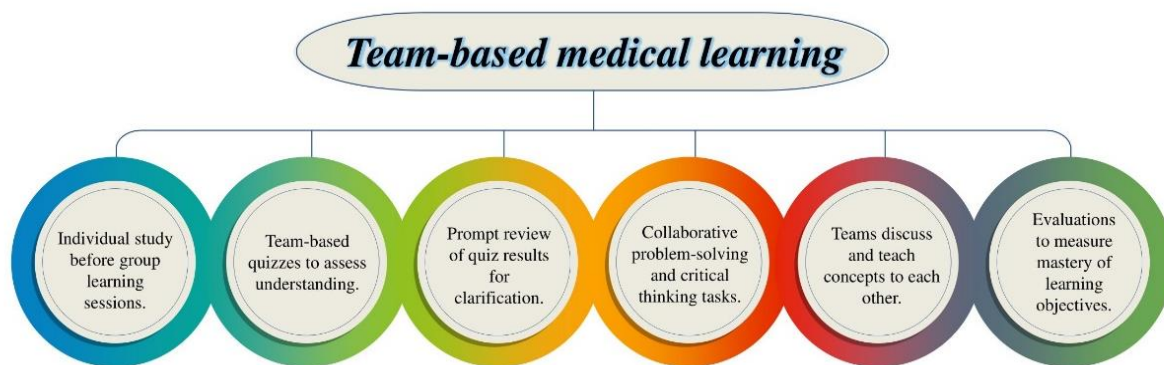
Figure 8. The team based learning and its implications.

4.8.2 Challenges of design and implementation of TBL

Although there are many benefits to TBL, implementing team-based learning (TBL) in an educational setting comes with its own set of challenges. Managing group dynamics can be challenging, as students may have varying levels of commitment, engagement, and communication styles. Some students may dominate discussions, while others may be passive contributors. Ensuring equal participation from all team members can be difficult. Some students may contribute more actively, while others may be reluctant to participate. Instructors need strategies to address these imbalances (Means et al 2009).

Resistance can be due to unfamiliarity with the approach, concerns about grading, or a preference for more traditional teaching formats. Assessing individual and team performance can be complex. Determining fair and accurate ways to grade individual contributions within a team setting can be a significant challenge for instructors (Cordovani and Cordovani, 2015).

4.9 Flipped classroom(FC)

Flipped classroom is new approach that helps professors to highlight active learning during class time by sharing students lecture materials and presentations to be watched at home or outside of class. One of the most exciting advancements in the modern classroom is flipped learning. Although it is accepted in the literature that Jonathan Bergmann and Aaron Sam's, who taught chemistry at a high school in the USA in 2007, had an impact on the recognition of the model (Figure 9). There are four pillars of Flipped Learning: Flexible Environments, Learning Culture, Intentional Content, Professional Educators (Ağırman et al 2022).

Consequently, both teachers and students have the opportunity to use the classroom environment more successfully. As a result, the FC Model makes room for collective and interactive activities and studies that will allow the realization of high-level goals agreeing with the Bloom's taxonomy (Anderson et al 2001) by taking the simple amounts of the subject out of the classroom. Additionally, all these are done without conceding the learning outcomes and content of the course (Ota et al, 1995). Obtaining feedback, peer learning encouragement and promoting reading in head away can allow the flipped classroom teaching effectively. Current research evidence shows that the flipped classroom approach improves student perception, learning, critical thinking skills, and motivation in comparison to traditional lecturing methods (Gilfboy et al, 2015). Through incorporation of audio-visual tools, students are provided with indefinite access to instructive material thus stimulating an interactive and independent learning experience (Kellesarian, 2018).

4.9.1 Benefits of flipped classroom

The flipped classroom model, where traditional lecture and homework elements are reversed, has gained popularity in education. Students engage with instructional content before class, allowing in-class time to focus on interactive and hands-on activities. This promotes active

learning, enhancing student understanding and retention. This flexibility accommodates diverse learning styles and ensures that students grasp foundational concepts before attending class.(Baker et al, 2000).
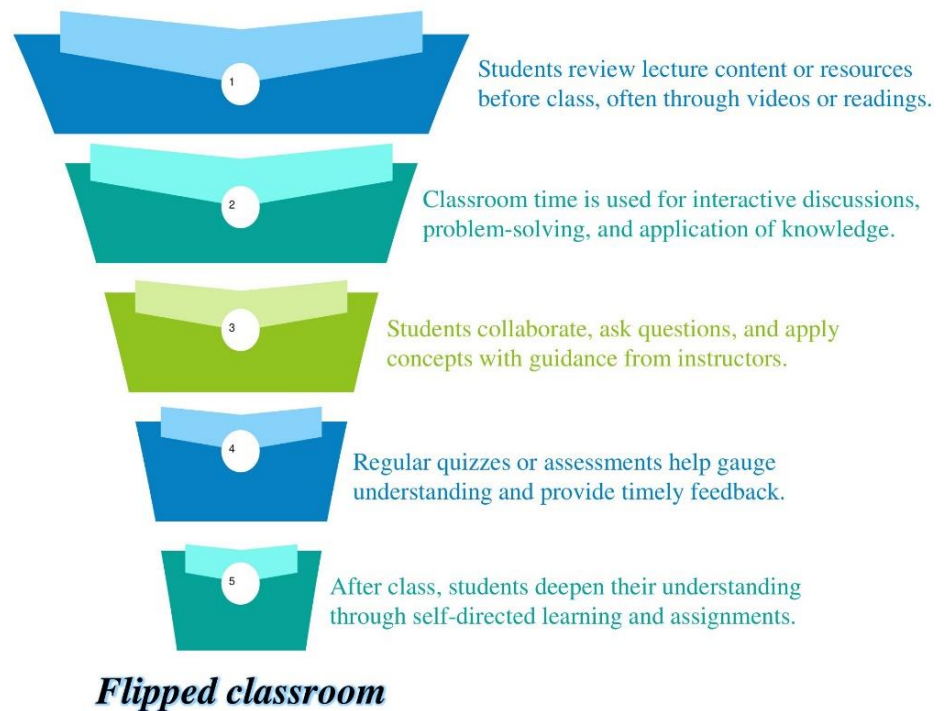

1 — Students review lecture content or resources before class, often through videos or readings.

2 — Classroom time is used for interactive discussions, problem-solving, and application of knowledge.

3 — Students collaborate, ask questions, and apply concepts with guidance from instructors.

4 — Regular quizzes or assessments help gauge understanding and provide timely feedback.

5 — After class, students deepen their understanding through self-directed learning and assignments.

Flipped classroom

Figure 9. Flipped classroom model in medical education.

4.9.2 Challenges of design and implementation of flipped classroom

The main identified obstacles are difficulty in self-regulated learning, heavy learning workload, lack of immediate support and lack of ICT resources. A flipped classroom can require more preparation time and mainly requires an active participation from both the professor and student as well.

Student-centered learning is not easy to achieve and requires consistent efforts from everyone involved, especially on the part of the educators, to be successful. It is this factor of additional effort that makes student-centric learning a complex affair. The need for additional training or resources to equip teachers to be student-centric teachers is only one of the hindrances in the path of implementing a student-centric learning model.

*4.10 Virtual (VR) and augmented reality (AR) learning*

Digital technologies are continually transforming the field of education and it has even entered into Medical Education. The health care industry is one of the sector where extensive learning is most required. With AR and VR tech, medical practitioner can learn mystifying surgical techniques on a 3D model in a virtual environment without performing on real individuals (Ota et al 1995).

The two studies conducted by Taffinder et al on assessing a psychomotor skill by a VR laparoscopic simulator. A virtual reality simulator for laparoscopic surgery models the activities needed to accomplish minimally invasive surgery and can generate a score for various aspects of psychomotor skill.

Two studies were performed using the simulator: the first one is to evaluate surgeons of different surgical practice to corroborate the scoring system; the second study is to assess in an unsystematically controlled way, the effect of a standard laparoscopic surgery training course (Figure 10).

Experienced surgeons were considerably more proficient, made fewer correctional sub movements and concluded the virtual reality tasks sooner than trainee surgeons or residents. The training course caused an enhancement in efficiency and a lessening errors, deprived of

a significant increase in speed when compared with the control group (López-Jiménez et al, 2022).
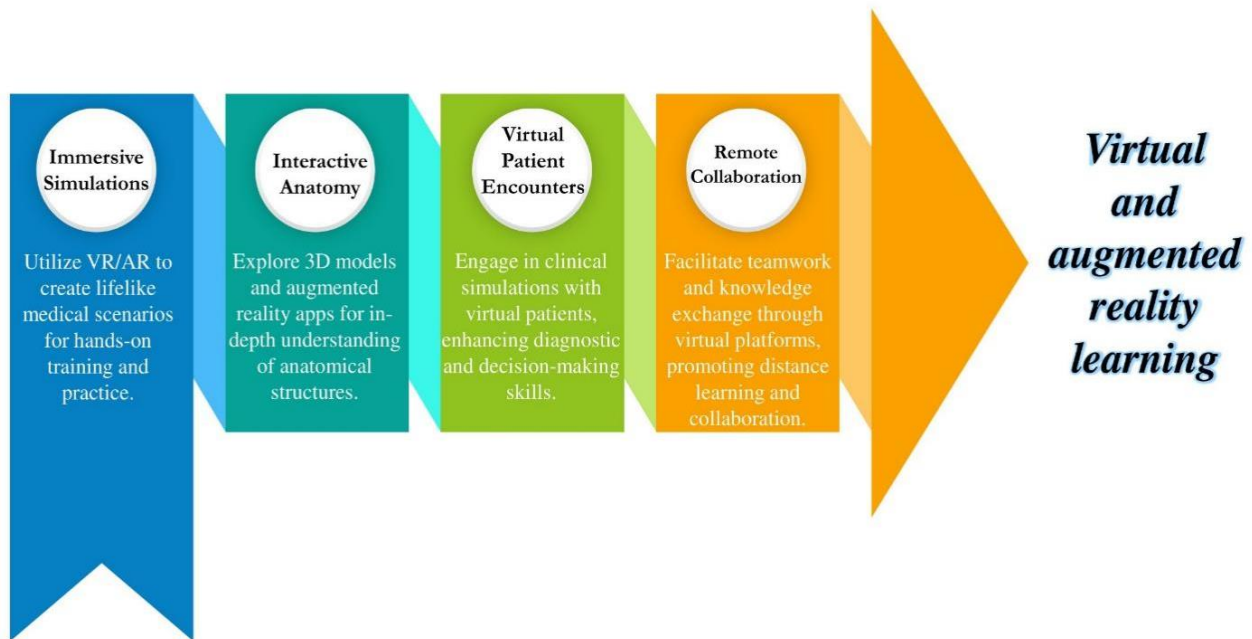
Figure 10. The importance of virtual and augmented learning.

4.10.1 Benefits of ER and VR learning

An experiential approach is relatively rare in many learning environments, especially for medical topics. AR and VR allow individuals to see the results of their actions directly. This type of learning is very useful because it helps in better grasping of concepts, if we have to see the histological structures it will give you 3 D idea to understand the concept better with the improved creativity. As well as increases chances for reflective learning with providing an overall immersive experience (Xu et al, 2023).

4.10.2 Challenges of design and implementation of ER and VR learning

VR proves to have the capacity to provide a seamless education for individuals trying to learn a second language. VR and AR can translate or transcribe educators' lessons, which enables students to understand and learn faster. During online learning, students often hesitate to speak or ask questions out of fear of mispronouncing words or sentences. With VR, interactions can be easier and more flexible.

AR/VR technology is expensive, and it takes careful orientation between the technology and the curriculum to achieve the intended learning outcomes. Some organizations may be timid to adopt AR/VR into their education delivery systems as a result of this.
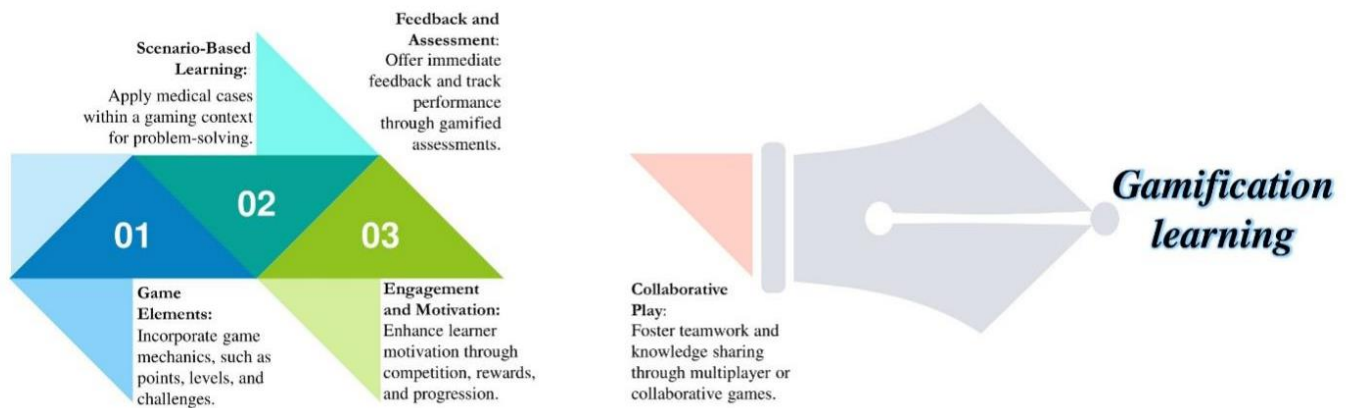
4.10 Gamification learning (Game based learning)

Gamification is an approach of new type of learning using game design techniques for non-game experiences for more effective learning and provides a more attractive environment for teaching and learning. Designing gamification based on learning theories (behavioral, cognitive, and constructivist), makes them more effective, and the application of learning theories in designing gamification is recommended (Bigdeli et al, 2023).

With the rapid development of modern technologies, game thinking and game mechanics attract learners and educationalists to solve problems with new way of learning. It is a unique growing teaching method in medical education and training programs with fast developing as an interesting and innovative teaching approach in the field of education currently.

Educational games, by application of game design and game elements in learning environments, motivate students to learn and improve the teaching and learning process.

The study performed by Lopez et all on three gamification elements were used to motivate students in classroom activities: badges were honored as appreciation to increase engagement, grades to indicate progression and performance in the subject and ranking for promoting competitiveness. All together 90 medical students in a General and Descriptive Anatomy

of the Locomotor System course were taught using G-SIDRA in the academic year 2019/2020. Smart bracelets were designed to collect heart rate measurements from 30 students with the aim of evaluating the impact of the gamification elements. The control group consisted of a sample of 110 students enrolled on the same course in the academic year 2016/2017 using non-gamified SIDRA (Van Gog et al ,2009) (Figure 11).

Figure 11. The role of gamification learning.

4.11.1 Benefits of game-based learning

The benefits of GBL on learners include augmenting their collective awareness, providing them with opportunities for active learning to improve solving clinical problems, and educating their clinical reasoning and managerial skills. GBL can enable educators to explore unique and practical teaching strategies, which contribute to the reorganization of current didactical activities. The emergence of serious games and gamification provides alternative approaches for educators to improve the medical teaching process. E. g.: Surgery techniques, sutural techniques. These teaching formats are well-received by learners and can create an immersive experience for students, considered effective, engaging, easy to understand, interesting, and educational in comparison with traditional teaching activities. Multiple teaching modalities of GBL also contribute to its further application, such as card, board, and even digital games using modern technology (Xu et al, 2023).

4.11.2 Challenges of design and implementation of game-based learning

They cannot yield significant outcomes in short-term gains and long-term knowledge retention sometimes. Finally, games are typically not considered mainstream material in medical teaching, and it is important to improve their popularizing rate and explore their potential explanatory mechanisms. (Jiménez et al, 2022).

5. Discussion

Generally, lectures have held a central role in the Basic sciences of medical education. Didactic lectures, as a formal method of information delivery, have long been the norm. However, this approach has encountered numerous challenges, prompting a reevaluation of our teaching methods to enhance the learning experience. Didactic lectures, while providing information, are often criticized for being passive and lacking effective engagement. The design and execution of these lectures sometimes fall short as active learning exercises, hindering students' ability to collaboratively enhance their learning experience.

Recognizing these challenges, there is a growing imperative to implement modern learning techniques. Active learning methods, technology integration, and collaborative approaches are becoming increasingly vital to foster a more dynamic and effective educational environment. As we move forward, let us collectively explore innovative strategies that not only address the limitations of traditional lectures but also empower our students to be active participants in their learning journey.

In the realm of medical education, the adoption of modern learning techniques is not just a preference but a necessity. Our evolving understanding of pedagogy underscores the importance of catering to diverse learning styles, especially in the foundational stages of medical education. (McCombs et al 1991).

Modern learning methods go beyond traditional didactic approaches, offering a spectrum of interactive, collaborative, and technology-driven tools. This shift is particularly crucial in addressing the variations in learning style preferences among our students. Recognizing and accommodating these differences are key elements in enhancing students' performance in the complex landscape of basic medical sciences.

By integrating modern techniques, we can create a more inclusive and dynamic learning environment. Whether through interactive simulations, virtual laboratories, or collaborative problem-solving exercises, these methods empower students to engage actively with the material, fostering a deeper and more comprehensive understanding.

Let us continue to explore and implement innovative approaches in medical education, ensuring that our teaching methods align with the diverse needs and preferences of our students.

In our ongoing pursuit of excellence in medical education, it is becoming increasingly evident that a more integrated and dynamic approach to the curriculum is not just beneficial but necessary. The bridge between basic and clinical sciences must be strengthened to optimize learning and foster student engagement.

The early introduction and exposure to diverse teaching-learning strategies play a pivotal role in this integration process. By providing students with a varied toolkit of learning methods, we not only enhance their understanding but also lay the groundwork for effective clinical practice. These methods are designed to cater to individual learning differences and promote a comprehensive approach by integrating various learning strategies.

Medical colleges are increasingly recognizing the value of early clinical exposure, realizing its potential to support vertical integration in preclinical studies. The synergy of basic and clinical sciences is a catalyst for a holistic understanding of medical concepts.

Undoubtedly, the incorporation of modern learning methods is key to facilitating the acquisition of knowledge and skills. By embracing innovation in our educational approach, we empower our students to navigate the complexities of the medical field with confidence.

In our pursuit of an optimal teaching and learning environment, it is imperative for educational institutions to take a proactive stance. The design, introduction, and early implementation of alternative teaching-learning strategies should be considered a cornerstone of our educational approach (Mc Lean et al, 2026).

By integrating these strategies early in the curriculum, we provide students with the freedom to explore and reflect on their knowledge. This not only fosters a more dynamic and engaging learning experience but also lays the foundation for a comprehensive understanding of medical concepts. As the landscape of healthcare continues to evolve, it is crucial that medical education keeps pace by expanding and modernizing its methodologies.

This forward-thinking approach not only meets the immediate needs of our students but also positions them as adaptable and innovative practitioners in the future. It is through the deliberate introduction of diverse teaching and learning techniques that we can truly revolutionize the medical education landscape.

Let us collectively embrace the responsibility to design and implement these alternative strategies, contributing to the expansion and modernization of medical education.

6. Conclusions

Learning is a dynamic and continuous process, and acknowledging the diverse learning styles of our students is paramount. In our pursuit of excellence, we must recognize that each student possesses a unique approach to learning. It is in this context that the integration of modern teaching and learning methods becomes not just beneficial but essential.

Several contemporary methodologies have proven effective in addressing these diverse learning styles within medical education. These include, but are not limited to, Case-Based Learning, Evidence-Based Medicine, Problem-Based Learning, Simulation-Based Learning, e-learning, Peer-Assisted Learning, observational learning, flipped classroom model, and team-based learning.

These student-centered alternative teaching and learning techniques serve to broaden students' thinking by introducing creative approaches to constructive knowledge acquisition. Furthermore, they contribute to the strengthening of professional expertise, fostering the development of essential skills, competencies, and leadership qualities in the medical field. There are few limitations in these teaching methods, every method will not be favorable to all the students based on the group of individuals and there courses each methods will be applicable.

Flexibility is key in medical education, and our curriculum should be adaptable enough to accommodate and incorporate multidisciplinary teaching models effectively and contextually. This flexibility should ideally commence from the preclinical years, setting the stage for a progressive and inclusive educational journey. Overall, the conclusion advocates for an adaptable and student-centered approach in medical education, recognizing the evolving nature of the learning process and the unique needs of individual learners.

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