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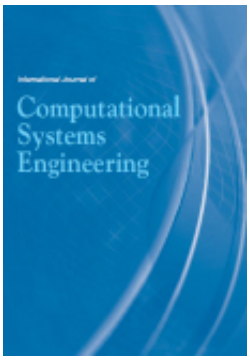

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Methodological strategies for control experiments in independent teaching and learning environment

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Abstract: The methods covered in this article have the potential to enhance students' learning in ways that are useful to them in their chosen fields of study. This approach is versatile and can be used in many contexts, such as but not limited to, online video courses, interactive features, and assessments. It is predicted that teachers will have access to an adequate number of resources. Students have the option of either taking part in a live session or utilising an online learning tool in order to fulfil the requirement of listening to the lectures. The application of educational technology in conventional classroom settings is carried out in a manner that is congruent with the concepts of the theoretical underpinnings of the educational methodology that is currently in use. In conclusion, a comparison is drawn between the many different strategies that were utilised.

Keywords: teaching and learning; methodological approaches; teaching efficiency; student participation; independent learning and professional categories.

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1 Introduction

Being a scientist or technician in today's society can be quite satisfying, particularly in light of the expansion that their area is seeing all over the world. Students are able to develop abilities in independent research with the use of technology in the classroom (Al-Qallaf (2020; Martínez et al., 2020; Elamrousy and Ammar, 2019). In the meantime, students are able to take a break and have some fun owing to the technology that has been integrated into modern classrooms. 'Smart classrooms' are now feasible for architects and builders to create as a result of recent technological developments in wireless network technology. It is possible to stimulate the interest of students in the subject matter that is being studied by giving them access to modern technology such as tablets and personal computers.

Students have the opportunity to benefit from a one-of-a-kind educational experience when they study in an organised classroom with a trained instructor. There has been a recent uptick in the integration of digital tools and strategies into more conventional approaches of teaching (Debets et al., 2020). This initiative gives students a customised study space to boost exam scores. Academics coined the phrase 'smart classroom' to describe how sophisticated technology are integrated into traditional classrooms (Law et al., 2019; Zvoch et al., 2019). These technologies include AI, big data, VR, cloud computing, and others. This concept refers to using all available technology tools and resources to create a bright instructional environment. Intelligent classrooms can be customised for each instructor while still engaging and educating pupils. Technology makes smart classrooms possible. Today's education system increasingly values the intelligent classroom (Kay et al., 2019). Recent studies of intelligent classrooms and the teaching of individual subjects have already outlined the conceptual framework that will support the advanced form of education in the next decades. This framework will be supported by recent studies of intelligent classrooms and the teaching of individual courses. Research on this subject is still in its infancy in China because only a small number of studies have been undertaken on the application of intelligent classrooms in the country. This is the case in spite of the huge economic boom that China has seen. To the best of our knowledge, no research conducted in the past has investigated the links between AI and musical education (Li et al., 2020). At this time, work is being done to develop AI-based pedagogical strategies that can be used in music classrooms at the middle school level. It is highly likely that we will put these strategies into action in the not-too-distant future. The next

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thing that needs to be done is to gather all of the pertinent data and carry out an in-depth examination of how this will affect education. This study will help in satisfying the needs of the new course idea, which is one of the reasons why it has such a significant practical value (Zhang and Shi, 2019). Both the instructional framework and the activities themselves (Carlucci et al., 2019) have provisions for conducting evaluations of the students' advancement in the direction of the learning outcomes.

It is not impossible to find answers to social issues by employing a large number of neural networks to process information in conjunction with one another. In order for an artificial neural network (ANN) to be able to conduct pattern recognition or data categorisation, it must first be trained to fulfil the prerequisites of a number of different neural wireless network models (Zhang and Shi, 2019; Xindong and Jingguo, 2019). The only way for it to meet the criteria at hand is to do it in this manner. You may break down massive amounts of knowledge into more manageable parts and arrange it into study pathways that are simpler to track and organise if you use an online learning platform. The incorporation of a wide variety of knowledge elements makes it possible to construct an efficient framework for a music knowledge system that can be used for online education. This system is capable of providing a wide variety of retrieval services (Litke et al., 2021; Mbise, 2021), including classification, subject keywords, and mind mapping, to name just a few of them. deciding which of several feasible groupings is superior given a number of options. The hyperplane, which can be located in either the high-dimensional feature space or the input data (María-José et al., 2021; Emirza et al., 2021), is one of the most important components that goes into the design of a wireless network.

The building of a hyperplane of this kind is made possible through the utilisation of numerous labelled training datasets, which can either take place in the input space or in a high-dimensional feature space (Simonsen and Rundmo, 2020; Reeves and Chiang, 2019; Zhou and Luo, 2019; Hou et al., 2021). It is possible to accomplish this goal by employing either the input space or the high-dimensional feature space. This is something that can be accomplished in either the input space or the high-dimensional feature space. You can choose either one of the options available to you. The input space is transformed into a high-dimensional feature space through the use of the kernel function, which enables wireless networks to solve nonlinear issues. The first thing that needs to be done in order to get ready for the lesson is to watch the video the night before it is going to be taught.

As a consequence of this, students will have a greater number of opportunities to practice their listening and speaking skills while in the classroom (Gholami et al., 2020; Jasmis et al., 2021). The primary purpose of data governance should always be to be of advantage to the company. If you are going to exhibit the data, you had better have access to data that is of an exceptionally high quality so that you can demonstrate the significance of the data. We have developed a value-oriented data program for music curricula by using these recommendations as a foundation. This program contains the following five basic components: data integration and cleaning, continual development of data quality, relational combing (data mining), forecasting, and visualisation (Costa et al., 2020; Bawack and Kamdjoug, 2020; Petrovskaya et al., 2020). When used in the context of a framework, data governance operations can assist companies in arriving at decisions regarding how they can most effectively optimise themselves (Alomari et al., 2020; Zhu et al., 2020). In the same way that other business operations at universities provide the data, they also provide the opportunity to make these selections.

2 The components and procedures

The educational programs that nations implement for their populations are one of the relatively few things that remain consistent from nation to nation. It's one of the few spots where there's a real chance for growth to happen, which makes it a great place to invest. Internet use is especially widespread in institutions dedicated to education and professional advancement, in addition to homes and other private locations.

Studies that are carried out in non-collaborative environments and under stringent experimental conditions offer itself to a wide variety of methodological approaches. Because of these methods, there is a wide variety of choice, and the possibilities for permutations and combinations are practically endless. The five inputs that are going to be used in the approach of this research are going to be presented to the participants in the control group. The new aspect of the suggested method is that it makes use of these different modes. The results that are based on entropy are then utilised to assess the outcomes, and it is determined whether or not the new way of education is more effective based on those findings.

When performing methodological experiments in non-structured learning and teaching situations, the following are some extra aspects to keep in mind:

It is necessary to conduct the experiment using a sample population that is large enough to ensure the validity of the findings. This will be feasible only if there are a sufficient number of participants taking part in the experiment.

It is important for members of a study group to have as many things in common as is practically possible. This will help them learn more effectively together. This will ensure that any differences in outcomes that are observed between the two groups are attributed to the differences in the instructions that were given, rather than to any confounding factors that may have been present in the experiment. This will ensure that any differences in results that are seen between the two groups are a direct result of the training method that was utilised.

Both the researchers and the people taking part in the experiment should, if at all possible, be kept in the dark about who will be assigned to which groups. This eliminates

or significantly minimises the likelihood of the experiment being biased in any way.

Experiments in which children are involved are particularly susceptible to unethical behaviour, but all experiments require careful evaluation of the ethical consequences.

It is of the utmost importance to ensure that all pertinent parameters are controlled whenever one is running an experiment in order to establish the efficacy of a unique instructional technique in a context that allows for self-directed learning and teaching. This is due to the fact that it is much simpler to obtain conclusions from an assessment that may be relied upon when certain experimental circumstances are controlled.

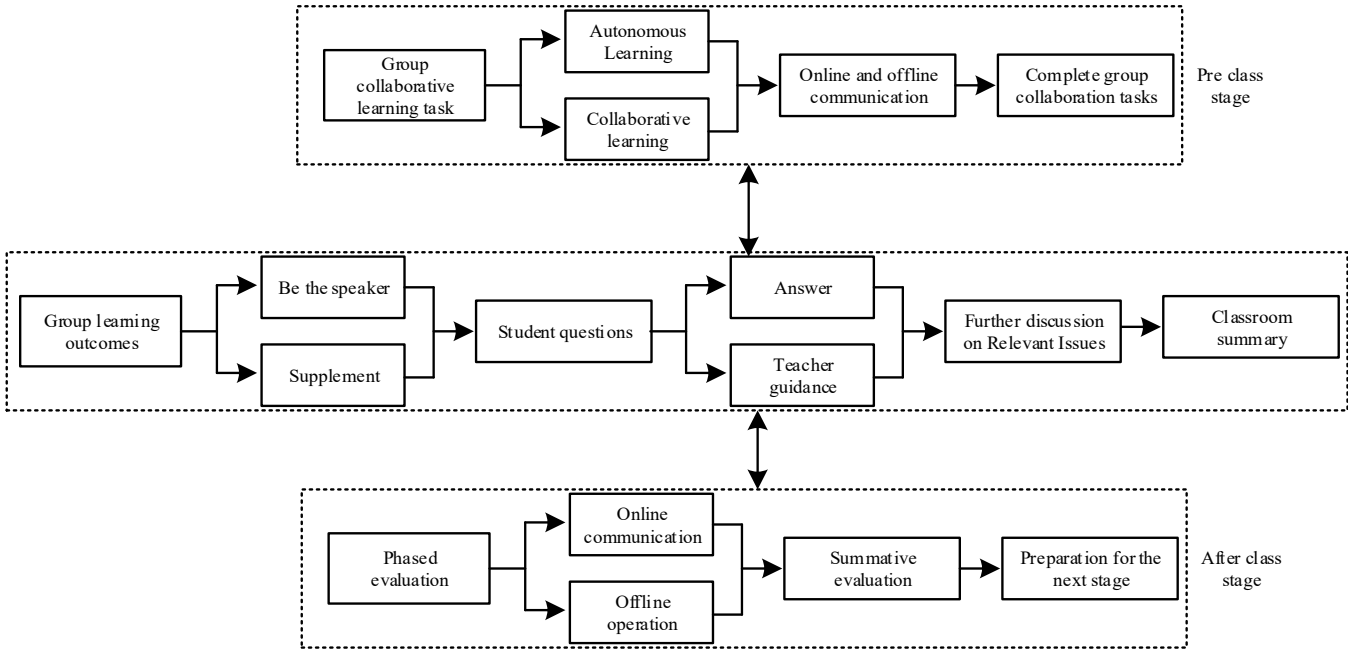
Figure 1 is an example of the essential framework for classroom education, which may be used to the presentation of any subject matter. This structure can adapt to any subject matter. One of the students in one of the classrooms or lecture halls at one of the educational institutions, which includes schools and universities, has disrupted the established order of things. All of these institutions are educational establishments. It is vital to employ a curriculum-building strategy that puts a focus on the students' ability to remain quiet while teaching research techniques in a more formal context. This is because the students will be expected to maintain silence. Although the educational materials include a powerful network infrastructure, professional educators are sluggish to want to study the existing situation and enhance the preschools. This is despite the fact that the materials contain a robust network architecture. On the other hand, these teachers are aware of the criterion that must be met. The purpose of the website is to ease the process of studying and practicing its material by including offline educational resources as well as resources that are oriented for professional students. A bigger effort is being made to enhance the number of opportunities for students to engage in specialised kinds of education, and this portion of that endeavour is a component of that larger effort. This is because the student will be exposed to a greater range of learning models and information if one of the so-called 'dynamic' teaching techniques or concepts is used. As a result, the student will have a more favourable overall experience in their area of study. It is anticipated that this will lead to an overall more favourable experience. This will take place in the case that one of the instructional strategies that have been suggested happens to be used. This approach is versatile and may be implemented in a variety of settings, including video lectures, interactive sections, and question and answer sessions, to name a few examples. It is the responsibility of the teachers to supply the students with sufficient material to cover all of the topics that are being discussed in their classes. The students are required to participate in the lectures, and they can either go to a live session or listen to the recordings at a later time. The use of methodological frameworks as part of the process of imparting and acquiring conceptual knowledge is going to be the focal point of this undertaking. The many pedagogical approaches are broken down in Table 1.

Teachers have the dual roles of enhancing the course content and maintaining communication with other groups during the pre-class stage. As seen in Figure 1, this need is shown. To successfully complete an activity, it is necessary to engage in two different types of learning: learning on one's own and learning with other people. Consequently, it is of the utmost importance that students make an effort to complete the assignments that have been assigned to them, whether it be homework or classwork. At this time, the ambiance of the classroom itself is quite important. The outcomes of the learning activities that each group has participated in must be reported by a designated individual, and after that individual has completed their report, other members of the group are free to provide clarification or additional information as required. It is possible for the teacher to provide further assistance to a student in the case that the student is unable to deliver an adequate response to a question. Based on the findings of each group, it seems that instructors may enhance the education of their students by suggesting significant themes for class discussion, guiding them through engaging arguments, and encouraging them to engage in intellectual competition with one another.

Table 1 Various approaches for teaching and learning

Strategy	*Description*	*Advantages*	*Disadvantages*
Controlled experiments	Participants are randomly assigned to either the control group or the experimental group. The control group receives the traditional teaching approach, while the experimental group receives the new teaching approach.	Can eliminate bias	Can produce statistically significant results
Quasi-experimental design	Participants are not randomly assigned to the control group or the experimental group. Instead, participants are assigned to groups based on existing characteristics, such as prior achievement or grade level	Can be used when random assignment is not possible	Can be less expensive than RCTs
Matched pairs design	Participants are matched in pairs based on their characteristics, and one member of each pair is randomly assigned to the control group and the other member is assigned to the experimental group	Can reduce bias	Can be used with small sample sizes
Cross-over design	Participants are randomly assigned to either the control group or the experimental group for a period of time, and then they are switched to the other group for a second period of time	Can reduce bias	Can be used with small sample sizes

Figure 1 Teaching and learning methodological approach



3 Methodological approaches for teaching and Learning

There is more to learning than simply studying, which often entails reading textbooks and attending seminars and lectures. The vast majority of people's life experiences can be summed up as a type of education at some point or another. It is absolutely necessary to make an attempt to motivate students over the course of the teaching process in order to provide pupils with new educational content. Students need to investigate the various ways in which they might put what they have learnt to use in order to value the efforts that they have put forth. The individual themselves, as well as their environment, should be sources of motivation. It is the duty of the teacher to demonstrate to the students, using a number of instructional methods and in a variety of scientific subjects, how to approach newspapers on a daily basis and how to use them throughout one's life. This is to be accomplished through a variety of educational strategies. It is essential to have a holistic strategy when designing educational programs, since this will ensure that all bases are covered. This was done in order to investigate the realisation of mathematics education. Altering the order in which the approaches are employed or not employing them at all can have unfavourable effects on the amount of knowledge that the students are able to take in from the material that is being presented to them. When procedures are applied in the appropriate sequence, successful outcomes can be accomplished. The following pedagogical practices ought to be integrated into the curriculum for the learning of mathematical concepts:

- Oral presentation method (OPM), in which the teacher talks about the content while the student listens and takes in part of the information that is being presented to them. The significance of this method cannot be overstated; yet, due to the fact that it is insufficient for providing a coherent explanation of the newly introduced material, the math lesson cannot be condensed into only making use of this method.
- The method of interaction (MI), which involves interaction between participants in the form of posing and finding solutions to a specific topic, is a fantastic technique to get kids thinking. MI involves interaction between participants in the form of posing and finding solutions to the topic. It is essential that the method be executed in the presence of undivided attention at all times. The ability of many mathematical concepts to be applied to real-world problems is one of the defining characteristics of mathematical education. A consequence is typically a circumstance in which the instructor conveys more complex ideas to the students, but the students do not embrace the basic principles because the students are unable to completely comprehend the instructor's explanation.
- The method of demonstration, sometimes known as MD, is a teaching strategy that involves illustrating or explaining abstract ideas by way of pre-planned exercises or instances. It is essential that tasks be distinguished from one another with regard to the characteristics of the issue at hand or the strategy that will be utilised to resolve it.
- The method of independent exercises, often known as MIE, in which the student completes the task independently once it has been given to them. The problems can be solved on the whiteboard or written down in a notebook, but they can also be completed with the assistance of software that has been developed expressly for mathematical purposes. It is feasible to complete work of this sort outside of the classroom;

however, it is recommended that the subject matter be more challenging in relation to the knowledge that is intended to be covered.

- Method of working with literature (MWL) – This approach is almost never applicable in teaching; if it is, it is typically contained in the independent work of students on a particular topic, whose presentation is done through a seminar paper. Moreover, if it is appropriate, it is almost never applicable in teaching. If it is used at all, there is practically never an instance where it is useful in the classroom. When employing this method of teaching in the classroom, students should have an easier time learning numerous ways to use literature and being able to accept different points of view on a specific concept. This should make it possible for students to acquire multiple methods to utilise literature. Students also benefit from this strategy since it helps them enhance their critical thinking skills.

Students, as a group, are distinct individuals who benefit from being taught through a range of pedagogical approaches. In light of this, it is absolutely necessary for the process of education to make use of methods that are suitable to the vast majority of the various learning styles. According to Mladenovic's research from 1986, people have a wide range of perspectives towards mathematics. In addition, the prerequisite skills and experience levels of the students can vary widely. When teaching mathematics, it is necessary for there to be informational feedback regarding both the work that the instructor is doing and the activities that each student is engaged in. The ability of students to use computers is not any more a required criterion for the development of such a connection; rather, the responsibility for fulfilling that requirement falls nearly entirely on the shoulders of mathematics teachers. The provision of participants with the knowledge and technical capabilities necessary to execute adaptive learning, either in part or in its entirety, by making use of a range of educational software is the major goal of teacher training. This can be accomplished by providing participants with the appropriate information.

3.1 Methodological approaches for conducting control experiments

To successfully carry out control experiments in contexts that are favourable to independent learning, it is necessary to give careful thought to both the research topic and the specific characteristics of environments that are friendly to independent learning. The following is a list of many methodological techniques that may be used to improve the dependability and efficiency of your experiment:

1 The techniques of randomisation and stratification: Participants should be assigned to experimental and control groups in a random fashion in order to reduce the possibility of bias and to guarantee that the results are comparable. The importance of this cannot be overstated in the context of autonomous learning environments, where the self-selection of groups according to learning preferences might bring variations that can be confusing. When pre-existing variations in participant attributes (such as previous knowledge or learning styles) have the potential to impact results, stratified randomisation is a method that may be used to further control for possible bias. This method involves stratifying the sample based on these factors before applying randomisation.

2 Ensuring that all groups are consistently equivalent: Ensure that participants in both groups have access to similar learning materials, pre-recorded lectures, and internet resources. This will ensure that the contents and processes are standardised. In order to reduce the amount of superfluous variability, it is important to standardise instructions, timelines, and feedback methods. If it is possible to do so, blind the researchers and the participants to the group assignment in order to decrease the possibility of bias in the data collection and analysis.

3 Measurement of the results of independent learning and learning: It is important to provide standardised pre – and post-tests in order to objectively evaluate the progress that has been made in learning. The use of online testing systems or automated scoring makes it possible to reduce the impact of the teacher and maintain uniformity. The collecting of databased on processes: For the purpose of monitoring students' autonomous learning behaviour, engagement with materials, and perceived progress, you may make use of online quizzes, activity logs, and student surveys. This may give insights into the processes that are responsible for the results that have been seen.

4 Obstacles that come with independent learning: One way to encourage the development of abilities for independent learning is to think about the possibility of offering a quick training or resources to promote successful techniques for independent learning before the experiment begins.

5 Methodological approaches with additional components: If doing a true random assignment is not feasible, you may want to investigate using other designs such as matched-pair comparisons or time-series designs. However, it is important to keep in mind that these designs may have significant limits in terms of causal inference.

In order to get a more in-depth comprehension of the ways in which participants experience and learn in the various settings, it is necessary to combine qualitative and quantitative data, such as test scores and interviews, respectively.

4 Methodological approach to develop teaching and learning environment

In the field of education, having a methodical approach is really necessary. Evaluation of continuous qualities with higher values is done to identify the level of information collection throughout the process of constructing a framework for education and training. A methodological framework known as the measurable correspondence hypothesis (María-José et al., 2021) has been created in order to solve the difficulty that is associated with the process of data transfer (correspondence). An order selection tree is generated by first calculating the information gain of each method ($I_m \in \{OPM, MI, MD, MIE, MWL\}$), then selecting the property with the highest information gain as the characterisation standard for each segment, and finally continuing this process until the termination condition is met. This process is repeated as many times as necessary until the tree is complete. The mathematical expectation expression formula of information entropy is as follows:

$$E\left(I_{event}\right) = -I_{event}\left(I \cap I_m\right) \tag{1}$$

Here, $I_{event} = P(I_m)$ stands for the established probability, I stands for the quantity of information pertaining to the event, and I_m stands for the amount of information pertaining to the individual.

As we get more knowledge, we make the first steps toward constructing a decision tree. When it comes to the various techniques, we do not know how to begin by correctly classifying instances based on their associated attributes. In order to determine how the entire instance space should be partitioned based on the attributes I_m, we build a decision tree based on the training instance set. If this is the case, the expression formula for the probability that the training instance belongs to a certain category is as follows:

$$C(I_m) = \frac{N}{\sum I_m log_2(1-e)} \tag{2}$$

Here N denotes the total number of training examples and e stands for each individual training instance's particular characteristic. The calculation formula for the degree of uncertainty in the pair partition of a decision tree is represented by the notation $I_m log_2(1–e)$.

The information source, which is typically the instructor, the information receiver, who is typically the student, and the information transmission mechanism, which is typically the channel, make up the components of a methodological framework. When the parcelling process is finished, in order to limit the quantity of data that is expected to be required for the order of the preparatory test subset, the feature with the most data gain is selected to serve as the test quality of the ongoing hub. This property is essential to the methodological strategy since it is used to partition the existing sample set into more manageable subsets (which are nodes). Because of this, the possibility of 'different classification blending' between the various book sets that are offered is diminished. According to the data hypothesis, in a world that is characterised by arbitrary impedance, the fundamental mechanism of information transfer that takes place is through the use of correspondence. Within the framework of this communication paradigm, information generators and conflict generators are seen as interconnected components of a chaotic cycle.

It is obviously inappropriate to choose and evaluate instructors just on the basis of their job title, which is 'teacher,' and many schools also place a premium on teachers' theoretical teaching abilities. This is occurring more frequently as a direct result of the current climate. Having problems with one's sight, one's perception, one's equilibrium, and one's framework are some of the most crucial reasons for this. In order to lay a strong foundation for a vocational education, which places a strong emphasis on learning that can be used in the real world, it is essential for students to develop practical operation skills. As a result of this, vocational universities do not yet have a system in place that is capable of evaluating the efficiency with which their faculty members instruct at vocational schools. The new method for evaluating teachers in vocational education calls for the endorsements of advanced skills and academic talents provided by higher vocational educators to be accorded the same amount of weight as the evaluations they get. This represents a significant departure from the conventional approach to evaluation. The development of qualified professors is a priority in vocational colleges, with a focus placed on the combination of a claim to fame and a specialty. the subjective requirement of a relationship that is mutually advantageous between vocational education and local economic growth, as well as the objective necessity of solving the problem of a shortage of vocational training teachers at vocational schools (particularly educators of notable specialty courses). The selection of jurors for the professional title review of higher vocational teachers ought to be based on their extensive familiarity and expertise with vocational education, and applicants ought to be evaluated in accordance with particular professional categories. If they so desire, instructors at technical universities are given the opportunity to sit for the professional licensure exam pertinent to their area of expertise. Once a teacher has obtained the professional designation, they are entitled to the same rights and advantages in the workplace as certified educators are. These potentially helpful frameworks for evaluating the qualifications held by vocational educators could be adopted as a standard in higher education if so desired. The next thing that needs to be done is to stick to the procedure that has been stated for developing standards for evaluating teachers.

Example study: A flipped classroom method, in which students view pre-recorded lectures on their own and participate in active learning activities during class time, has been shown to increase learning results in comparison to a standard lecture format in an atmosphere that encourages autonomous study. Below is an example:

Step 1 Random assignment

The students should be randomly divided into two groups, with the goal of ensuring that their academic performance and prior knowledge are equivalent. During the experimental phase of Group A, participants have access to pre-recorded lectures and are responsible for completing online quizzes on their own before each session. During class time, the emphasis is placed on applying knowledge via activities such as group projects, problem-solving conversations, and activities. Participants in Group B (the control) attend typical lectures in person, during which the lecturer presents the subject and responds to questions. During the time allotted for independent study, the primary emphasis is on reviewing lecture notes and completing reading assignments.

Step 2 Independent learning environment for student groups

The pre – and post-tests are completed separately by both groups using the same online platform. This helps to reduce the amount of effect that either group or the teacher has on the students. Outside of the classroom, both groups have access to the same learning resources (such as a textbook or materials available online), such as the same materials. The individual's progress may be monitored via the use of online quizzes and assignments, which can be used to assess the level of engagement and comprehension.

Step 3 Define the control variables

We ensure that all groups have equal access to the resources necessary for autonomous learning, including technology and support services. In order to ensure that all of the groups are on the same page, standardise the pre-recorded lectures and the materials used in class. It is important to maintain control over the workload of the teacher by allocating comparable amounts of time to both teaching methods.

Step 4 Perform data collection and analysis

In order to determine the learning outcomes by administering pre- and post-tests that are in line with the goals of the course. In order to evaluate the level of student participation and their perceptions of the learning experience, it is necessary to collect additional data such as attendance, online activity logs, and student questionnaires. In order to compare the learning results, engagement indicators, and student feedback between the two groups, you need do a statistical analysis of the related data.

This method offers substantial data that demonstrates the efficacy of flipped classrooms in comparison to standard lecture formats in the context of autonomous learning environments. In doing so, it identifies certain learning objectives for which each strategy gives benefits. This information is also used to drive future course design, the distribution of resources, and pedagogical tactics for settings that encourage individual learning.

5 Results and discussion

In the process of evaluating the methodological framework, which is based on OPM, MI, MD, MIE, and MWL models for teaching and learning methods, this assessment comprises an experimental comparison between the five approaches, as well as comparisons with traditional methods and methods that do not include any novel approach. This is evaluated using the percentage of confidence in the accuracy. The findings of the experiment are presented in Tables 2–6. When compared to other techniques, it has been observed that the OPM, MI, MD, MIE, and MWL models have a higher level of confidence and accuracy.

It appears that the MI model provides the highest level of confidence (87.1%), followed by the OPM model (76.9%), the MD model (67.1%), the MWL model (61.1%), and the MIE model (59.6%). The results support these conclusions. This demonstrates that the MI model is superior to other models in forecasting the degrees of confidence that students will have when they are in the midst of learning something new. On the other hand, interpreting the MWL model is the hardest of the three models, whereas doing so with the OPM model is the simplest. Therefore, the model that should be utilised should be one that is compliant with the prerequisites of the application at hand. If you care most about how certain you can be in your forecasts, the MWL model is the right choice for you to make. If, on the other hand, interpretability is a significant concern, the OPM model presents a more straightforward alternative.

Figure 2 Comparison in terms of student participation (see online version for colours)

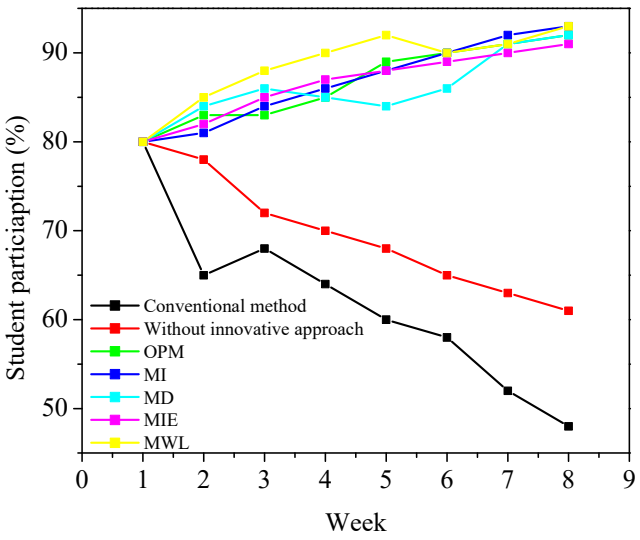


Table 2 Confidence Accuracy （%）of teaching and learning methods for OPM approach

Number of experiments	*Teaching learning method based on independent learning*	*Teaching learning method without any innovative approach method*	*Teaching learning method based on OPM*
1	72.169	64.809	78.644
2	63.448	65.419	77.434
3	66.428	64.120	75.282
4	62.833	69.280	76.331

Table 3 Confidence Accuracy (%) of teaching and learning methods for MI approach

Number of experiments	*Teaching learning method based on independent learning*	*Teaching learning method without any innovative approach method*	*Teaching learning method based on MI*
1	75.801	74.531	82.374
2	69.155	71.337	81.484
3	61.132	64.603	83.147
4	73.314	68.163	83.671

Table 4 Confidence Accuracy (%) of teaching and learning methods for MD approach

Number of experiments	*Teaching learning method based on independent learning*	*Teaching learning method without any innovative approach method*	*Teaching learning method based on MD*
1	56.062	55.046	67.276
2	55.000	57.179	65.976
3	52.623	56.028	67.424
4	59.254	57.075	67.751

Table 5 Confidence Accuracy (%) of teaching and learning methods for MIE approach

Number of experiments	*Teaching learning method based on independent learning*	*Teaching learning method without any innovative approach method*	*Teaching learning method based on MIE*
1	48.853	47.709	62.708
2	50.165	48.860	59.334
3	47.681	47.745	61.534
4	48.704	49.070	54.962

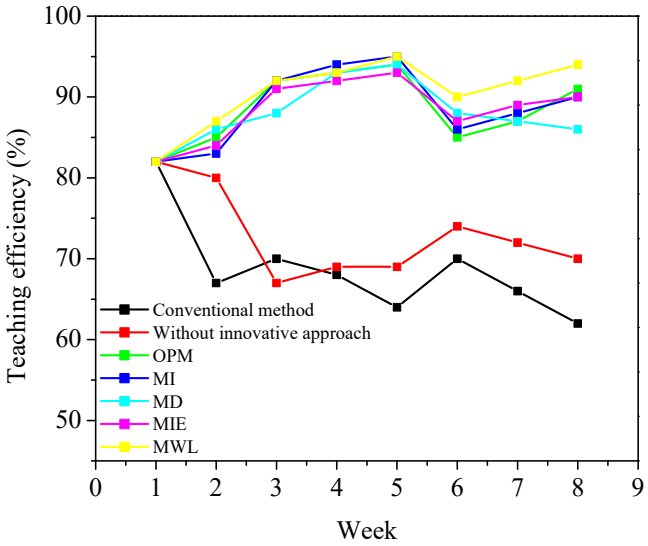
Table 6 Confidence Accuracy (%) of teaching and learning methods for MWL approach

Number of experiments	*Teaching learning method based on independent learning*	*Teaching learning method without any innovative approach method*	*Teaching learning method based on MWL*
1	50.511	49.377	64.243
2	51.811	50.517	60.899
3	49.349	49.412	63.079
4	50.363	50.725	56.566

Table 7 Comparison of student participation and teaching efficiency

Method	*Student participation*	*Teaching efficiency*
Method of oral presentation (OPM)	High	Medium
Method of interaction (MI)	High	High
Method of demonstration (MD)	Medium	High
Method of independent exercises (MIE)	Medium	Medium
Method of working with literature (MWL)	Medium	Medium

Figure 3 Comparison in terms of teaching efficiency (see online version for colours)



Figures 2 and 3 present the comparison among student participation and teaching efficiency per week respectively. Table 7 presents comparison of student participation and teaching efficiency among various methodological approaches. When compared to the MD, MIE, and MWL approaches to education, it is generally agreed that the OPM and MI teaching methods are more engaging and interactive than their respective approaches. This is the outcome as a direct consequence of the fact that both OPM and MI seek

active participation from their students throughout the entirety of the learning process. Most people agree that MD and MI, two types of teaching methods, are the most effective. This is because when educators employ these strategies, they are better equipped to give pupils guidance that is not just clear, but also precise. Which teaching and learning approach will be most effective in terms of student participation and the instructor's ability to impart knowledge precisely depends on the nature of the subject matter being taught, the students who will be taking part, and the instructor's approach to implementing the approach. On the other hand, OPM and MI have a reputation for being helpful pedagogical tools because they boost student participation and guarantee accurate presentation of material. This is one of the main reasons why they are generally seen as being outstanding teaching approaches. It is very important to keep in mind that the following discussion is only a basic comparison of the different ways to teaching and learning. The particular results that can be obtained with each strategy will vary greatly depending on the particular setting in which it is applied, therefore it is important to keep this in mind. This is due to the fact that every strategy possesses its own particular complement of benefits and drawbacks.

It is possible that educators may be cautious to accept new technology, particularly if it requires considerable modifications to their instructional strategies or if it raises worries about the confidentiality of student data. There are legitimate issues about the manner in which the emotional data of students is gathered, maintained, and used. Data security solutions that are both robust and transparent are very necessary. It is possible for machine learning algorithms to perpetuate pre-existing biases, which might result in interpretations of student feelings that are either unjust or erroneous. Choosing training data with care and developing ways to reduce bias are both very necessary. It is important that the framework should not replace the human aspect of teaching and learning; rather, it should enhance it. The feedback should be used as a tool to inform the choices that teachers make, and they should utilise it to keep control over the learning process.

6 Conclusions

Because today's students have access to a much wider variety of educational resources than they ever have in the past, there has been an increase in the prevalence of independent teaching and learning environments. This has led in an increase in the number of independent teaching and learning environments. In situations like these, it is of the utmost importance to think up and put to the test novel teaching tactics that will enable students to make the most of the educational opportunities that are available to them. The methodological technique that was provided can be utilised to conduct evaluations of alternative pedagogical approaches. The participants of the control group are provided both the traditional technique of education as well as the novel method. The results of the two groups are then compared so that it can be decided whether or not the new technique of education is more effective. The proposed method has the potential to be an effective instrument for the testing of novel approaches to education in settings that place an emphasis on self-directed learning and instruction. There has been an increase in the quantity of research conducted on the application of novel techniques to the teaching and learning process, specifically for the purpose of evaluating new instructional strategies in settings that permit independent teaching and learning. When compared to the traditional technique of instruction, the results of this study indicate that the approach that was proposed is determined to be more effective in terms of both teaching and learning than the conventional method. Discovering successful and new teaching approaches that can be employed in environments that encourage individual teaching and learning can be accomplished with the help of the strategy that has been provided.

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