

STRATEGIES FOR AUGMENTING BLENDED LEARNING APPROACH TO TEACH THE TOPIC 'ELECTROMAGNETISM' AT THE SECONDARY LEVEL

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Abstract

In the 21st century, knowledge-built economy is driven by identical factors - globalisation and the Information Communication Technology-ICT. The vivacious role of schools in preparing students with knowledge, higher-order thinking and performance skills to succeed in the 21st century can be accomplished through blended learning approach. Blended learning or hybrid learning is a mixture of online learning and face-to-face learning methods. A critical goal of blended learning is complete understanding of the content. The student needs to identify everything about the content, so blended learning tools help with different learning strategies whether it is online or offline. There is no shortage of learning methods here. This can be achieved depending on the student. One of the main factors disrupting traditional learning is student numbers. However, this is not a barrier to blended learning. The limits of traditional teaching methods in physics are complex. Therefore, there is a need to change the traditional practices for expanding educational experiences in the field of physics. Rote learning is not suitable for physics. Imagination is more important, so improving imaginative thinking skills can be considered as one of the strategies for learning physics. One of the most challenging subjects in the field of physics is electrodynamics. However, it is most useful for the future world and by understanding electromagnetism we can predict the nature of the universe. A gifted person can simply approach the subject with the traditional method, but there is still a misconception as to whether that person is able to fully understand electromagnetism. A blended learning approach allows anyone to massively understand electromagnetism. Most students need time to understand the main concepts in electromagnetism. There is also vagueness in the acquisition of concepts because every sentence in the book "Introduction to Electrodynamics" 3rd Edition by David .J. Griffiths gives different meanings. Many strategies can be used using blended learning, such as TPACK, PAC, and course redesign using web lecture, screen casting, pen casts, studio classrooms, etc. The curriculum can include formative assessment, problem solving, guided learning, and multiple choice clicker questions. . The ultimate goal is to make self-study time more efficient. Therefore, this paper aims to study the different strategies that can be used to teach the topic "Electromagnetism" in blended learning mode, hoping that this higher gradation will help students to expand their effectiveness in learning, understanding and applying the concepts.

Introduction

In the last two years, the entire world, including India, has been facing a major Covid-19 pandemic situation. This impact has hit the field of education the most. For children in grades 7, 8, 9 and 10, the process of acquiring knowledge has slowed down due to this disaster. This may be due to a lack of age-appropriate knowledge. In this age group, brain development will be

limited by inappropriate training. So, a revolution is necessary for this situation to begin. The Fourth Industrial Revolution Joins the Learning Crisis; now is the time to reinvent education and connect it with an extraordinary technological revolution. So, we want to create a fourth industrial revolution as a backup plan for all contingencies. Technology-assisted learning is developing as an essential component of teaching materials in the current educational context. A key part of this development is e-learning or online learning, which has become a vital element of contemporary education as the student becomes increasingly computer literate, computers become more readily available, and the demand for technology-based learning at a time that is convenient for the student increases.

So, we want to create a fourth industrial revolution as a backup plan for all contingencies. Technology-assisted learning is developing as an essential component of teaching materials in the current educational context. A key part of this development is e-learning or online learning, which has become a vital element of contemporary education as the student becomes increasingly computer literate, computers become more readily available, and the demand for technology-based learning at a time that is convenient for the student increases (P Sivakumar, 2019). A blended learning environment includes not only the physical presence of instructors and students, but also student ownership and control over the time, place, path, environment, and pace at which learning occurs (Banditvilai, 2016)

Blended learning

Learning theories like constructivism, cognitivism, and behaviorism can all be combined in blended learning (Linghong Li, 2017). There are five essential components of the blended learning process: (1) Live Events: Synchronous, instructor-led educational activities in which all students engage simultaneously, (2) Online content: A course that a student completes on their own, at their own pace, and when it suits them. (3) An environment for collaboration in which the student connects with others, (4) Assessment: Amount of student knowledge. Pre-assessments can occur before live or self-paced events to regulate prior knowledge, and post-assessments can occur after scheduled or online learning events to measure transfer of learning. (5) Reference Material: Workplace reference materials that enhance retention and transfer of learning (Carmen, 2005).

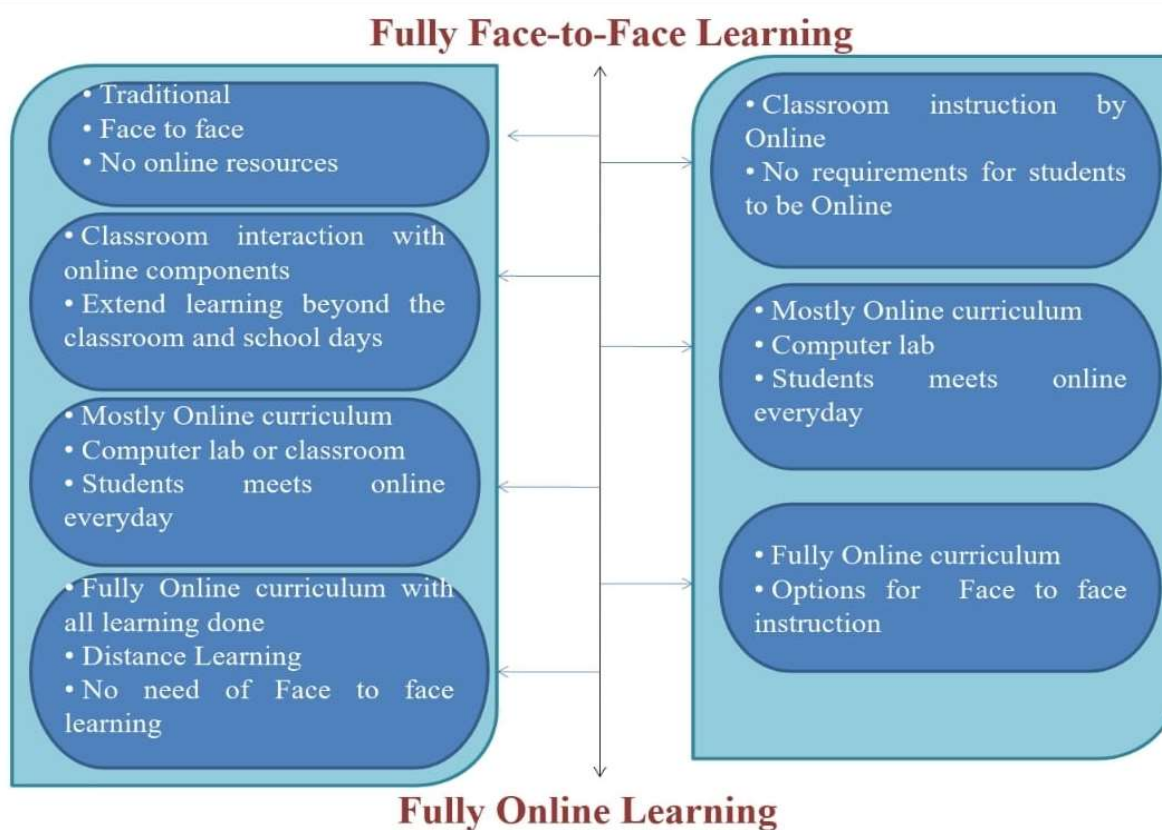
Blended Learning of this century

Greater access to individualised learning from resources and subject matter experts is provided through blended learning. The addition of an online learning component will enable learners to access learning at any time and from any location. Online learning will flourish with self-paced learning, allowing those who learn more quickly to advance while others who study more slowly to do so at their own pace. Online learning also allows the option of learners staying at home without travelling down to the school, especially in a situation such as Covid-19 quarantine. Charles Chew conveyed that blended learning allows greater accommodation for learners' and teachers' diverse backgrounds, interests, and strengths.

Many pieces of research are demonstrated critically towards the methods of the delivery which match the subject matter knowledge and diversity of the students. The researchers are looking for new strategies of blended learning not only in the science subject but also in all other

areas. A Blend of methods and approaches is more likely to produce a richer active learning experience and achieve the anticipated learning outcome (Charles Chew, 2015). Fig 1 shows traditional face-to-face learning to fully online learning (Watson, 2008)

Fig 1: Blended Learning Continuum (Watson, 2008)



Physics is one of the most challenging subjects to learn and teach without proper training and practice. It is a systematic study of all natural resources such as light, sound, air, movement of molecules etc. In 9th grade, the basics of mechanism were taught according to the syllabus. The curriculum aims to deepen the basic principle of electricity and magnetism in the practical world and is required in education. Continuation exists in upper grades and colleges, so the foundation is important to the survival of higher education. Electromagnetism is one of the subjects that have characteristics that are quite difficult to learn because it is abstract and comprises elements of mathematics, specific vector coordination in three-dimensional Cartesian, etc. The learning process is still for clarification on the concept of the abstract through lectures and demonstrated through pictures on the blackboard and the viewer. Sometimes the process of learning in the classroom cannot be required to remember the limitation of time (Ali, 2009). Through the Blended Learning approach, we can implement many innovative and creative ideas of different learning methods in the course of electromagnetism. This will motivate students to learn, increase their readiness to take on educational challenges and encourage the practice of self-learning.

Different Blended Learning Strategies for Electromagnetism Concept Transaction

Eindhoven University of Technology conducts research on blended learning and physics courses by integrating blended learning at bachelor's, master's and doctoral level. Levels with

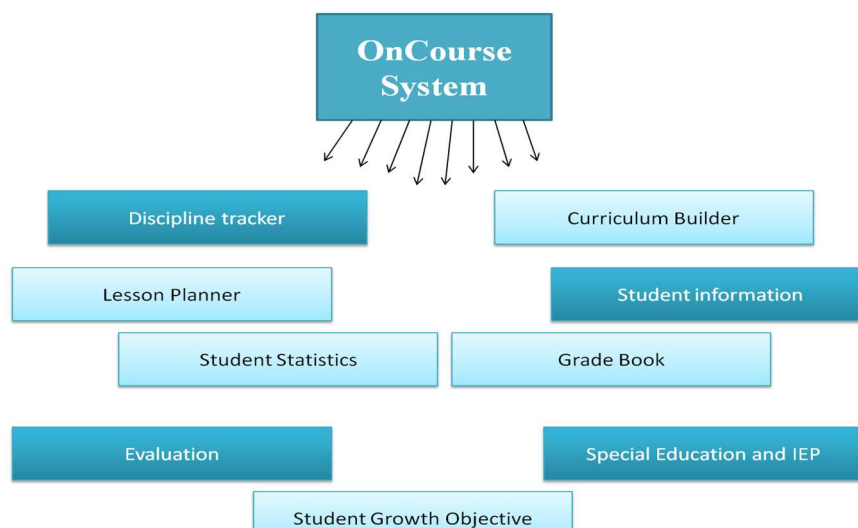
the right educational strategies and led programs for teachers to professionalize them according to these strategies. Some of these strategies are On course, Web lecture, Screencast and Pencast. Execution of the TPACK model, which is a merger of content and pedagogy into an understanding of how particular aspects of subject matter are organized and adapted. Researches show the new ways of Blended learning towards physics learning. They show their practice in the following areas: (1) learning environment design, with the tools EduTools, Blackboard, Desire to Learn, and e-College.com, (2) Classroom Teaching with video as an introduction, a live demonstration from Interactive Demonstration Books, live examples through video clips from the Internet, and i-Clicker Concept Questions Practice from Textbook supplements, (3) online teaching using Blackboard, (4) Learning Assessment with Online Homework System, Writing project: Lab report, and Online Quiz.

On course

Oncourse deals with how to create a website for every course offered at the university. With Oncourse, students and teachers can access course syllabus and grades; connect via course email, chat rooms and discussion forums; and access to online quizzes and surveys. So, Oncourse helps bring together all school information and resources for administrators, teachers, parents and students in one web-based tool. It allows users to view, collaborate, and work on all topics related to the school day, such as classes, curriculum, discipline, student information and statistics, grades, teacher evaluations, special education, and student growth goals. Figure 2 shows the nine portals inside the Oncourse system, which is on the home page.

From the David J Griffiths textbook, one of the topics Electromagnetism, electromagnetic induction with Faraday's experiment, as well as Mutual induction and Self-induction was introduced. Using the Oncourse System, we can systematically cover this section by going into the syllabus folder, creating a physics syllabus and submitting all available resources such as books, one of the help books that is similar to Griffiths is Electricity and Magnetism by Edward M Purcell. Purcell's explanation is more flexible compared to Griffith's. This is how we can test more features in the Oncourse System. A teacher can create a lesson plan with a course template that an administrator can review and edit what is required.

Fig 2: Nine portals of the Oncourse system



Web Lecture

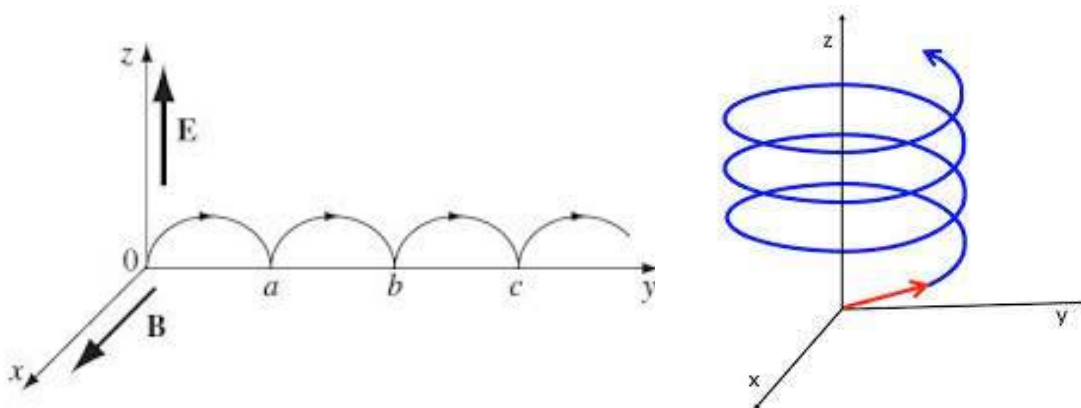
A web lecture is a collection of lectures that can be accessed anytime, anywhere. In the exam, revision is more useful. If you missed a lecture, keep it; if a particular part of the subject was exciting, it can be retrieved again and again. This leads to more interaction about the subject; even a differently abled student can effectively follow the lecture. For teachers, changes can be easily accessed by adding additional resources, comments, questions, and feedback.

A web lecture is a live recording of a lecture. This takes place in a standard lecture space while we take our lecture as normal. It is usually used to support students by allowing them to review the lecture if they did not understand something the first time or were unable to participate. In Electromagnetism, the story of Faraday's discovery of electromagnetic induction can be done through this web lecture. Circuit diagrams can be drawn using drawing applications such as Smart draw, EdrawMax, ETAP, AutoCAD Electrical, etc., and a PowerPoint presentation can be used to give a live lecture or live demonstration of an experiment using a web lecture and can be accessed anytime, anywhere using a link. The rise of the electric field from the magnetic field is quite a problematic part to explain, so the combination of multiple strategies takes place in the form of lectures, demonstrations, presentations, video presentations, etc. can be activated through web lectures.

Pencast Tool

The topic, Cyclotron Motion and Cycloidal Motion, from Griffiths' Textbook, explains the archetypal motion of a charged particle in a magnetic field is circular, with the magnetic force providing centripetal acceleration. When a positive charge is placed in a magnetic field, the charge jumps and moves in a circular motion due to acceleration. Even though it is a positive charge, it goes counter-clockwise, which looks like a cyclotron motion. If an electric field is added, the effect of the electric field affects the charged particle and is transmitted as a cycloidal motion. Fig 3 shows the motion of a particle in a magnetic and electromagnetic field.

Fig 3: Cycloid Motion and Cyclotron Motion of a charged particle



We can explain this Cyclotron motion and cycloid motion using Pencast tools. Electromagnetism is a part full of derivation explanation; we can't explain this like a story. The behaviour of each particle is confirmed through derivation, after that the findings, which we call formulas, tell us the characteristics of the charged particle in the Electric field, Magnetic field, and Electromagnetic field. So, explanation based on the teacher is more time-consuming and

needs more preparation to demonstrate. The solution to this problem can be found through the use of these Pencil tools.

A pencil is a video presentation of handwritten text, formulas or drawings, accompanied by an audio commentary. Pencil is done using a digital pen. There are two types of Pencil: one is A Kahn Style Pencil and the other is Pencil for writing on paper. Kahn Style Pencil is a format that displays a black background with multi-colored lettering and lettering on paper. Pencil is a format that displays handwriting or drawing on a sheet of paper. Using Pencil, we can clarify the above statements. It feels like a lecture on a blackboard, but it is more flexible, it does not damage any page, it is easy to remove writing without fear of dust, it can be anywhere, anytime, and it is not a messy whiteboard. Pencil depends on the combination of hardware and software we choose to use. Some of the Pencil tools are Smooth draw, Krita, Cam Studio open source and Live Scribe. Figure 4 show one of the Pencil tools used in explaining cyclotron motion.

Fig 4: Example of the Pencil in Circular motion

The screenshot shows a presentation slide with a purple header containing navigation tabs: "Direction of Force on Charges", "Combining Electric and Magnetic Fields", "Cyclotron Motion", "The Cyclotron", and "The Hall Effect". The main title is "CIRCULAR MOTION". Handwritten in red and green ink are the following equations and notes:

$$F = qvB = ma_r = \frac{mv^2}{r}$$

Labels "Newton" and "UCM" are written above the equation. Below it, the radius is given as:

$$r_{cyc} = \frac{mv}{qB}$$

To the left is a battery symbol. Below that, the frequency is given as:

$$f_{cyc} = \frac{qB}{2\pi m} \text{ indep. of } v$$

On the right is a photograph of a cyclotron with a glowing blue particle path. A small "9/15" is in the bottom right corner.

I-Clicker System

Repetition is the most important part of learning electromagnetism. Before that, the teacher has to show and practice each student to find the solution to the problems in the textbook. In a constructivist approach to classroom learning, teaching-learning is a student-centered method, and students are more involved in finding solutions, and the teacher is only a mediator. One of the difficulties of electromagnetic inductance is: When the current I_1 changes in the magnetic field B , the flux through the circuit C_1 changes, as a result of which an electromotive force is induced. What is the emf equation? How can we denote Flux in terms of current I_1 ? What is the reason for the negative sign? These questions lead to the formula for self-inductance. Knowing without meaning cannot retain this concept in memory. Thus, interaction is another effective way of this learning. For this problem, the iClicker system is used to collect responses from students in the classroom.

iClicker is a wireless radio frequency system. Figure 5 shows the iClicker system used in the Physics Department of New York University. They attend training programs to research i-

Clicker ILDs and examine how well students' basic physics concepts are taught using i-Clicker ILDs strategies and the outcome is more effective.

Fig 5: i-Clicker System in the University of New York(Linghong Li, 2017)



The iClicker system is an easy to learn, easy to use, dependable, and reliable tool which endorses student engagement and peer learning (iClicker.com, 2011)

Conclusion

The fourth industrial revolution has arrived in our country, which has transformed our education system in many ways, including how we study and teach. In education, M-learning, blended learning, virtual learning, artificial intelligence and gamification have all reformed pedagogy. After conducting research, we find many strategies that are successfully implemented in the field of electromagnetism. Students are also more interested in electromagnetics courses when they use a blended learning strategy, as determined by their attendance, frequency of participation in the learning process, activity in discussions, and capacity to ask questions and answer difficulties. It was also evident that there was a high retention power due to blended learning in electromagnetic topics. By practicing blended learning strategies from the middle grades can lead to interest in the subject of physics without ever becoming a burden on the student, we can increase the diversity of individuals who choose science careers and expand the pool of scientifically literate citizens. This may encourage physics teachers to use blended learning to improve high academic achievement and retention.

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