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A study the efficiency of E-Learning & Complex object-oriented programming in education

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Abstract: This study examines the efficiency of e-learning methods in teaching complex object-oriented programming (OOP) concepts within the education sector. E-learning usually refers to structured and managed learning experiences and may involve the use of internet, software; other media and telecommunications. With the increasing adoption of digital platforms, the research explores how virtual learning environments, interactive tools, and multimedia resources influence the comprehension and application of OOP principles among students. The analysis compares traditional ceaching with e-learning approaches. However, the study also identifies challenges, such as the need for self-discipline and potential technical barriers, highlighting areas for further improvement.

Keywords: OOP, E-learning, Education, Traditional Classroom

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INTRODUCTION

The term "object-oriented" has been used as a catchword in recent years. Terminology invoking "objects" and "oriented" in object-oriented programming made its first appearance at MIT in the late 1950s.The concept of E-learning is very broad. It was coined in late 1990's as the technological enhanced learning mechanism through internet. There are learning environments can depend on the learning objective, target audience, access (physical, virtual or both) and type of content. The different techniques are evolving in E-learning. This the age of WWW and we are living in a globalized era, where the world massively being connected. The E-learning initiatives have connected the whole world and have removed the barrier of age, place, time and socio-economic nature. The technological revolution has created has created a new dimension in whole education scenario. The field of education has tried to exploit wed as communication channel to connect distance learners with their learning resources.

E-learning usually refers to structured and managed learning experiences and may involve the use of internet, software; other media and telecommunications. Because of the flexible nature of eLearning and since it provides right information in right time & right place, students are now more familiar and feel more comfort in this new education system. There have been a number of problems faced by teachers, teaching OO programming to college students. Students find it very difficult to understand object-oriented concepts like classes, constructor invocation, polymorphism and other object-oriented concepts. The student who has been exposed to procedural programming, find it a little difficult to move towards object-oriented programming. It takes some time for them to understand object-oriented concepts. Student cantered

learning for programming classes are very effective.

E-LEARNING: A NEW DEVELOPMENT IN EDUCATION

As the use of ICT becomes more widespread, individuals are increasingly exploring each and every aspect of the internet through a variety of electronic interactions. One sort of distant learning is e-learning. Through online learning, students who are unable to attend normal classrooms can still access a variety of courses. Postal delivery used to be the norm for this form of education, but as the Internet has grown in popularity & accessibility, it has mostly replaced it. Online learning is another name for this type of education. We can explain or characterize e-learning in a variety of ways. According to the WEIP 2005_1, **HOLM**, 2006. E-learning was defined as "the merging of the Internet with traditional educational methods" by LineZine [WEB 01]. those who study online Online education encompasses many different models and practices, including but not limited to: learning on the World Wide Web, learning on computers, virtual classrooms, & digital collaboration, according to the Glossary. This encompasses the distribution of media via the World Wide Web, local area networks (LANs), wide area networks (WANs), audio & videotape, satellite, interactive television, and compact discs.

TECHNOLOGY-ENHANCED LEARNING USING ICT

Virtually every kind of E- learning can benefit greatly from the resources made available by modern ICT [KARA 2014]. The administrator of the institute can administer the online learning system successfully with the help of various Learning and Management Systems (LMSs), which are often software applications. Specifically developed for the delivery of instructional programs, such as course content & variety of approaches, the online, Internet-based learning management system [MAHD 2008] [BHUA 2012] that allow students to communicate with their instructors and work together with their classmates. Teachers using online learning platforms should have experience with various forms of electronic communication and information dissemination. Institutes set up virtual classrooms for e-learning because students can't be physically present in the classroom and can't communicate with their teachers face-to-face. The following are examples of ICT technologies & approaches used in online education: [ANDR 2007] [BANE 2017_7]

Broadcasting on radio and television

The radio has been around since the 1920s, while television has been there since the 1950s. Institutions are also utilizing these technologies to aid with e-learning. There is no substitute for radio when it comes to language instruction, and television allows instructors to reach a large audience simultaneously.

Virtual classrooms

An excellent idea, the virtual classroom is ideal for distance learning. The most appealing feature of a virtual classroom is the ability for both instructors and students to access the system simultaneously, simulating a traditional classroom setting. The two most important aspects of an online learning system are the capacity to hold web conferences and chat. Additionally, the conversation session can be recorded for future reference.

Conferencing using audio and video

When it comes to e-learning systems, teleconferencing is only one more type of technology that can work. Audio conferencing, audio-graphic conferencing, & video conferencing are the three main components. The majority of audio conferencing takes place over telephone lines. A hybrid of audio and visual elements, such as still images, symbols, or text, is called audio-graphic conferencing. This type of conference approach is commonly used in online health courses. The process of conducting a video conference include not only exchanging audio but also visual content, such as videos.

The games of role playing

As internet connectivity has improved, role-playing games have become more accessible to students, either in the form of standalone CD-ROMs or through online multiplayer sessions. Games like "Star Wars," "Dungeons & Dragons," "Battletech," and similar titles are examples of this type. Language learning often makes use of multiuser dungeons (MUDs) & multiuser dungeon Object-Oriented systems (MOOs). In addition to facilitating communication among players from all over the globe, these games boost players' creative capacity, storytelling ability, & problem-solving abilities. Many other ICT tools and techniques, such as Web conferencing, Computer Aided Instruction (CAI), etc., can be effectively used in online learning.

TYPES OF E-LEARNING

The two main types of e-learning are synchronous and asynchronous, depending on the time of day.

Synchronous e-learning

The word "synchronous" refers to the fact that everything happens simultaneously. Synchronous online learning typically makes use of chat & video conferencing as the primary means of student-teacher interaction. The instructor & students in this type of class meet virtually and engage in real-time communication regardless of their physical locations. Skype, Zoom, Google Hangout, and various Learning Management Systems (LMS) like WizIQ are among the platforms utilized by universities to offer students real-time online learning.

Asynchronous e-learning

Students enrolled in asynchronous online courses have the freedom to study whenever it is most convenient for them, as opposed to the rigid time constraints of synchronous courses. Technologies like email, blogs, message boards, eBooks, CDs, DVDs, etc. can be utilized in asynchronous e-learning. With this form of online education, students and instructors can still study even when they don't have access to the internet.

TRADITIONAL LEARNING AND E-LEARNING

The traditional, classroom-based method of education is well-known to all of us. Debates, seminars, tutorials, practical lessons, etc. are just a few of the many alternatives to the conventional "chalk and talk" approach to education. When taking classes online, students must rely on the Internet to communicate with their instructors. Differentiating between conventional classroom instruction and online learning is the focus of the section that follows.

- **Globalization:** One major benefit of online education compared to more conventional classroom settings is that distance learning is not restricted to a certain geographic region. Online courses provided by these schools make education accessible to everyone, wherever in the world.

- **Portability:** E-learning allows users to access their courses from any mobile device, be it a laptop, tablet, or smartphone. Since location is irrelevant to this type of education, one can make the most of their free time.

- **Study material presentation:** When it comes to presenting the learning materials to students, e-learning is the way to go. In a traditional classroom setting, it can be quite challenging to display extensive documentation. However, with the help of a slide show & corresponding links to online resources like manuals, videos, and e-books, teachers can easily accomplish this task.

- **Cost-effective:** E-learning is better value than traditional learning. In their 2005 essay "Cost effectiveness and cost efficiency in e-learning," QUIS (Quality, Interoperability and Standards in e-learning) outlined numerous factors that make e-learning more cost-effective compared to traditional methods of education. For instance, compared to traditional classroom settings, online learning eliminates travel costs for both the instructor and the student, and paper is also saved because no printed materials are required.

- **Renowned educators all over the world:** Students in any field can benefit from studying under a master educator. Experts from all over the globe may teach students from any part of the globe thanks to online education.

- **Attendance:** While students in conventional classrooms are required to be physically present in order to grasp any given subject, online students have the flexibility to study at their own speed with recorded voice and video. This is a major perk of online education compared to more conventional methods of education.

- **Ultimate flexibility:** E-learning benefits working personnel. They can choose a time that is convenient for them to learn without having to move anyplace.

- **Monitoring student development:** With conventional learning, monitoring student development is a breeze because of the ability to engage in direct engagement. However, scheduling evaluation tests on a regular basis is not only difficult, but also time-consuming. Conversely, a Learning Management System (LMS) facilitates online education by recording and reporting each student's progress in real time.

- **Discrete:** It could be challenging to sit through a classroom lecture if you're elderly or have a physical impairment. Here, online education really shines.

E-LEARNING SYSTEM ARCHITECTURE

A conceptual model, the architecture of a system serves to clarify the formal description and relationships between the things depicted in the model. As a result, the principles and architecture of any system can be better understood [KARF 2005]. See Figure 1.1 for a schematic of a safe online education system [BANE

2017_6]. The three-tier architecture is common in web applications, including e-learning. The client initiates communication with the server by sending a request, &server responds by displaying the requested information. As a general rule, the administrator or developer of the relevant e-learning institute maintains the server, while the students are considered the client in this context. In order to get their hands on e-learning related documents like a registration certificate, study materials, grade reports, etc., students use web browsers to submit requests online. The databases of the relevant institutions usually hold all these papers. Firewalls are used by all companies for security purposes. To protect the institute's internal network from the wider outside network, a firewall either software or hardware, or a mix of the two is set up. A firewall protects an organization's internal data from unauthorized access, alteration, or denial of service attacks.

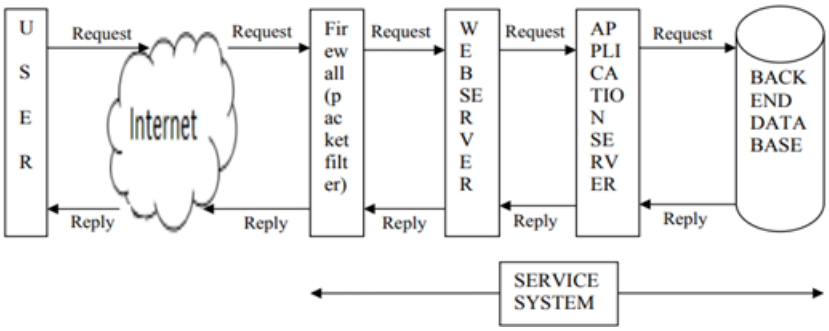

Figure 1: Architecture of a protected E-learning platform

The web server receives the study materials from the application server, and the application server retrieves the documents from the back end database upon receiving the document request. Finally, the information reaches the student after passing past the firewall and into the internet. Although a firewall is necessary for access control purposes, it cannot eliminate all potential threats. Together with this architecture, we can apply a few authentication approaches to further improve the system's security. Electronic learning involves the transmission and reception of massive amounts of data, both textual and otherwise. Data management & information security are fraught with difficulty. Digital signatures, digital certificates, digital watermarking, and steganography are the authentication approaches that have been the focus of our investigation. Our proposed thesis does not include other matters pertaining to information security & management.

OBJECT-ORIENTED PARADIGM FOR AUTHENTICATION TECHNIQUES

Our suggested models are based on Object-Oriented design techniques, which adhere to the Object-Oriented paradigm and make use of all the benefits of OOP [BALA 2006] [SUBH 2010]. You may classify programming paradigms into five main groups. [WEB 09]:

1. Procedure programming paradigm.
2. Imperative programming paradigm.
3. Functional programming paradigm.
4. Logic programming paradigm.

5. Object-Oriented programming paradigm.

Structured programming is the foundation upon which procedural programming rests. The program is broken down into smaller pieces, called functions, in procedure oriented programming, which follows a top-down approach.

There isn't much of a difference between procedural & imperative programming. While blocks and scope are important to procedural programming, they are not necessarily present in imperative programming in its entirety. A few instances of imperative programming languages are C, FORTRAN, & BASIC.

By avoiding changing-state and changeable data, functional programming [WEB 12] views computation as the evaluation of mathematical functions & provides a style for constructing the structure and components of computer programs. Included in this category of programming languages are F#, Common Lisp, Scheme, and Wolfram Language (also called Mathematica).

The majority of logic programming relies on formal logic, with programs written in a logic programming language that expresses facts and rules about the domain of the problem through a series of logically structured phrases. The logic program is declarative, meaning it primarily concerns itself with identifying the problem rather than offering solutions [WEB 13]. Prolog, Datalog, and Answer Set Programming (ASP) are three main families of logic programming languages.

Data and objects are the backbone of the OOP paradigm. A large number of popular programming languages include extensive support for OOP capabilities, usually in conjunction with imperative & procedural programming. These languages include C++, Python, Java, etc.

The preceding research shows that the Object-Oriented paradigm & Procedure-Oriented paradigm are the two most popular approaches to computer programming. Thoughts of a new programming paradigm gave rise to the Object-Oriented paradigm, which was then expanded upon to include Object-Oriented analysis & Object-Oriented design techniques. In 1960, the Norwegian computing center created the first Object-Oriented language called Simula, which meant "Simulation of real systems." Then, in 1970, Alan Kay and his colleagues created a personal computer called a Dynabook and utilized the first pure Object-Oriented language called Smalltalk to program it [WEB 14]. Coad adopted the behavioral principles of Object-Oriented methods in 1990, while Grady Booch laid out the blueprint for the whole Object-Oriented design methodology in 1986.

CONCEPTS OF OBJECT-ORIENTED PROGRAMMING (OOP)

Implementing software utilizing OOP has many benefits, such as increased programmer productivity, higher software quality, and reduced maintenance costs. The main benefits of OOP, which may be applied to any system, will now be quickly reviewed [WEB 16].

- Any system can be represented and understood with the help of OOP, which provide a clear modular structure for the programs.

- A well-defined interface is provided by each module, ensuring the security and confidentiality of data and providing specifics on how to implement it. With the right access specifier, you can conceal the inner

workings of any system.

- Using object-oriented programming, defining the abstract data type is a breeze.
- OOP allows the programmer to easily maintain any system by creating new objects with minor modifications to existing ones.
- By utilizing object-oriented programming, developers may do things like extend the utilization of existing classes through inheritance and remove unnecessary code.
- OOP makes it easy to manage software complexity.
- The programs are highly applicable to real-life scenarios since OOP provides object-oriented programming.
- Some properties of object-oriented programming make it easier to divide programs into models, which is useful for bigger projects.

To further improve their compatibility with actual e-learning systems, our suggested models are also enhanced with OOP concepts.

FEATURES OF OOP

Many programmers prefer OOP to Procedure-Oriented programming because of its many useful characteristics, such as objects, classes, data abstraction, encapsulation, inheritance, polymorphism, dynamic binding, and message passing. In the sections that follow, we will go over these characteristics.

Objects

Participants in an e-learning system, such as the instructor, the administrator, and the student, are typically represented by objects, the fundamental run-time entities of an Object-Oriented system. The objects communicate with each other through message passing while the application runs. You have to be picky about which things you use in ORP. There is data and code in objects, and the code allows you to work with the data. In an online learning environment, when a teacher and a student exchange digitally signed course materials, the teacher acts as an object holding both the data and the code needed to digitally sign the materials. They then communicate with each other through message passing.

Classes

Data and code are both contained in objects, and classes allow for the bundling of the complete set of data and code. Objects are the only things that use memory; classes do not. This is an example of a C++ program that generates digital signatures.

```
class Digi_sign
{
  public:
    int hi, vi;
    static int P_obj(int, int, int);
    int readmessage();
    int signi(int, int, int, int);
    friend static int Hi(int, int);
    friend int generate_prime();
};  //End of the class
```

The Digi_sign class we suggested earlier has two member functions designated as friend functions and all of its members are publicly disclosed, serving as an access specifier.

Data Abstraction and Encapsulation

Major characteristics of any OOP include data encapsulation & abstraction. Program data and program functions are the backbone of any object-oriented programming framework. Encapsulation is the process of combining data & functions into one entity. Under OOP, no one outside of the system may access these data. Data hiding, often known as information hiding, is a prominent aspect of OOP. It is accomplished by using access specifiers such as private, public, or protected.

By excluding unnecessary context and explanations, data abstraction helps to portray key qualities. The object-oriented programming paradigm relies on classes, which employ the abstraction approach to store and make use of abstract functions & attributes. The classes are called Abstract Data Types (ADT), the functions are called member functions, and the attributes are called data members.Because our suggested models adhere to OOP principles, they incorporate data abstraction & encapsulation features that enable us to safeguard our data from unauthorized access.

Inheritance

One further crucial feature of OOP is inheritance. It is possible to inherit properties from a parent class in OOP. The new class can inherit the characteristics of its parent class as the parent class is already declared in the current code. The ability to reuse existing classes is made possible by this attribute, which also permits hierarchical classification. This allows the programmer to add new functionality to an existing class without changing it in any way; this is called reusability. A Digi_sign class was utilized in the preceding example. Admin, a new class that derives from Digi_sign, will take on the characteristics of its parent.

```
Class Admin : public Digi_sign
{
  Private:
    int s_key, msg, sign, Ri;
    int get_sec_key();
 Public:
    int pk;
    void get_ri();
    Receiver send(int, int);
};
```

Admin is a publicly accessible subclass of Digi_sign in the given example. Meaning the class Admin has access to both the public & private members of Digi_sign, including the data members and member functions described within.

Polymorphism in OOP

The capacity to assume several forms is another crucial idea in OOP. In other words, it's the capacity to redefine methods for derived classes, and it signifies that an operation's behavior might change depending on the context [WEB 17]. Operator overloading occurs when an operator acts differently in different contexts, while function overloading occurs when a same function name is applied to execute many sorts of operations.

Dynamic Binding

The code linked to a specific procedure call is unknown until run time, a feature of object-oriented programming known as dynamic binding, late binding, or run time binding. Polymorphism and inheritance are also linked to dynamic binding.

Message passing

The OOP method is able to mimic real-world conditions thanks to the message-passing property. A collection of objects that exchange messages with one another constitutes any OOP.

Message forwarding describes this method. There are essentially three main stages to it:

1. Developing object-and behavior-defining classes.
2. Object creation from class definition.
3. Object communication.

All things considered, OOP is preferable to POP when it comes to big, real-world programs because of the aforementioned ideas.

CONCLUSION

This study used OOP challenges and how to leverage E-learning technologies to overcome them.

Reviewing the relevant literature helps to illuminate both the current research strategy and its potential limitations. When doing research and gathering material for a literature review, the Internet is invaluable. Research on related subjects is reviewed in order to address learning difficulties in OOP education at institutions in both rural and urban areas. Our research will help the government save money while still offering high-quality education to students, teachers, and the general public by reducing the cost of traditional classroom instruction & increasing access to online learning resources. The government will have an easier time providing educational programs & facilities through networks and ensuring educational equity in the country when this sort of framework technology is used in educational institutions or universities.

SECTION TITLE 8

SECTION TITLE 9

SECTION TITLE 10

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