Collaborative Learning System-Enabling Interoperability Between Learning Tools

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Abstract - **In recent years, the online educational system had an ascent shift from individual learning to learning in collaboration. Earlier, people had to use different tools for different purposes in individual learning, but this paper proposes the concept of interoperability between the learning tools which is termed as Collaborative Learning Systems to create a better learning experience and gain knowledge through an interactive platform. The paper presents the proposed architectural design, data flow representations and certain evidence to show that Collaborative learning is more useful and beneficial than the traditional learning systems.**

Keywords: Collaborative learning, Individual learning, Interoperability, Data Flow, Learning Systems, Learning Experience, Online Platform

I. INTRODUCTION

Earlier, the online educational system was solely dependent on the individual learning. The concept of individual learning has always emphasized on an individual learner. The pace of learning is based on the ability of the learner. Although students have access to computers but the computers in a single room are only resources from where students can retrieve information, and this doesn't improve the learning ability of the students. The learning pace also slows down. Hence the concept is trapped with a certain problem which is a concern at present. In the individualized learning, the learner is entirely dependent on the educator, and hence it becomes difficult for the educator to focus completely on a single individual. Also learning individually is a tedious process, and it's not only about the pace, but even the intensity of the learning process is scanty. There is also an acknowledgment of individual differences that is when questions are raised; different students will have different opinions that will reflect the wide range of perspectives along with interpersonal development (help students who have difficulty with social skills).

The Collaborative system will be used to integrate the collaborative learning tools and maintain the interoperability among these tools [1,7] that is instead of using different tools for different specifications there will be a single platform which will be the combination of the experiences that are adapted from the tools of other learning environments. Learners will be able to capitalize on each other's resources & skills to meet the new level of competencies. So the system which has been proposed will deal with all the drawbacks of individual learning as well as it adds up various functionalities to the existing learning

systems. This type of learning can be used with various terminologies like cooperative learning, collective learning, Blended Learning, peer learning and team learning.

The Collaborative learning system is an amalgamation of different learning tools [1,7]. It's a platform for learners to debate, to have discussions, to interact with each other, to share views and exchange various kinds of information. The interaction can be between the teacher and student or student and student or the course instructor and the respective students enrolled within it. This system also involves various online tests and evaluation of assignments by the teachers. The teacher can present its views or comments to that particular student. The model will consist of the administrator, users as the participants and the professors/teachers who will have the interaction with the users. The students are provided with multiple options like they can take tutorials after joining the curriculum, can give online tests, ask queries from the professors and get their doubts clear from them. The users will be students while the professors as users too will have a major role in the learning system. The students will have the video calling facility with the teachers. The student will be enrolling in any course plan that they wish to learn and will have an appropriate access to the course materials and will be able to get their assignments evaluated time by time by the professors.

People may often interchange words like Cooperative learning and Collaborative learning, but one should be cognizant that both are separate terms with distinct significance. Cooperative learning is dividing the work task among group members and presenting at the end individually which makes the student digressed from the learning process. It's not a preferable learning process rather than a forced process for completion of the task. Collaborative learning is all about learning "together" and sharing the knowledge among themselves which ameliorates the learning process as well as the student's ability to perform. Another emerging concept called Blended Learning which has been referred as "Third Generation" learning [12]. Blended learning means a combination of learning delivery methods, maximizing face to face interactions with latest computer and information technology. Hybrid learning is a synonymous term used in place of Blended learning [12]. Similarly, a system called Tele-Collaboration where there is an interaction between distant learners by telephony and internet technology is

encouraged by the teachers as an area of growing interests [3]. The system meets the current and future needs of the learner by the facilities it's providing. Learners can interact from anywhere and any part of the world. The system acts as a well-defined platform for them as well as maintains the group diversity. Learners may also lead for a big project to create a revolution by interacting among themselves forming a private group where critical discussions can be held.

II. RELATED WORKS

The ENFI Project by Gallaudet University and the "5th Dimension" by the University of California are some of the foundations of Computer based Collaborative learning [8]. In fact, ENFI was the first ever project to develop software for textual communication between students (Chatting) [8]. The 5th Dimension was developed to enhance the reading and the writing skills for students [8]. This kind of projects played a vital role in integrating the computer and information technology into the educational field.

Gerry Stahl, Timothy Koschmann, Dan, and Suthers supported network based collaborative learning as an emerging branch of the learning science concerned with studying how people can learn together with the help of computers [7]. Their research was about using the computer to support collaborative learning. They believed that the computers in the classrooms are not sufficed to make students learn at an efficient pace. They confine the students into a single room and is inhuman for training purposes [7]. Hence computer based collaborative learning will be an emerging concept in the following ways [7]:

• The videos, text and the content might be available as the resources for the students, but it is not enough because even a text book acts as a useful resource but doesn't necessarily improves the student performance [7].

• The teacher effort per student can augment by frequent interactions with them as well as the course material placed by them [7].

• Students can express themselves more freely and may interact with each other on a single platform from different distances where they can share and gain knowledge from each other. This will create a healthy competition [7].

• This will facilitate an F2F (face to face) collaboration where collaboration focuses on construction and simulations. Groups can interact in a group to discuss topics, solve complex problems and debates, spreading awareness among various subjects, etc. [7]

• They also differentiated cooperative learning from collaborative learning by their definitions.

In 1970, the software designers began to envision the learning technology employed artificial intelligence models to be adapted to learners. Throughout the 1980s and 1990s, various studies took place in the Collaborative learning and technology which had an early workshop addressing this system was "Joint problem solving and Microcomputers"

took place in San Diego in 1983. In 1998, Paul Black & Dylan William [10] believed that several studies showed firm evidence that teachers consider the perception of the student and its role in self-assessment as strategy and formative strategies are incorporated in such systematic approaches as mastery learning. Based on the nature of feedback, a more detailed and theoretical analysis is followed, which provides a basis for a discussion of the development of theoretical models for formative assessment [10]. In 2006 Redmond, P & Lock, J.VA [9] believed that at the center of this flexible framework, the online collaborative educational experiences where knowledge creation and knowledge in action are the fundamental principles. The educators were able to get knowledge of how to design, develop and implement an authentic educational experience [9].

In 2007, Hyo-Jeong So and Thomas A. Brush examined the relationships among students in collaborative learning environment about their social presence and satisfaction in such type of conditions [11]. They studied the relationship between these three variables and identified critical factors related to them. There were 48 graduates as participants who took a blended format course in health education and worked on a collaborative group project based on HIV-AIDS preemptive plan development. Data was collected from student perception questionnaire and personal interviews. The analysis indicated that students engaged in collaborative learning have positive perceptions which imply student who have high perceptions of collaborative learning would be more satisfied than the lower perception ones [11]. In 2008-09 Andreas Harrer and Niels Pinkwart [1] came up with a reusable software design that aimed to integrate several learning environments into one single learning tool which is the concept of collaborative learning system which led to "Scalable Adapter" [1] a concept which was introduced and had the main motive to adapt conditions from different types of learning environments and convert into a single learning tool which will enhance its usefulness and feasibility.

An example of Collaborative learning implementation which is highlighted in Edupia Schools, the students were utilized with the daily class worksheets and periodic group tests designed to be more challenging than individual homework or exams, to enable students quickly learn how they can solve problems as a group that they might not have struggled with on their own. Collaborative learning enabled the students to engage more interaction and maximize their knowledge. More than 1200 studies compared to indicate that collaborative learning improved student time on tasks and encouraged to learn, their interpersonal relationships and expectation from personal success. A meta analysis of students in a small group work to individual work was done where it was found that students in the small group were more benefitted rather than individual learning. The lower ability students did well on mixed groups whereas the medium ability students did best on homogeneous groups. In more than 40 studies of elementary, middle and high school classrooms the comprehension text was improved by

discussion based practices and critical thinking of students. Think and share, Group writing assignments, Group Grid, Case study are few of collaborative learning strategies which involved the group of study. This kind of group study develops a student in terms of knowledge, self-esteem, responsibility, interaction and understanding diverse perspectives, critical thinking for the management of large projects, leadership skills, and oral communication.

Another example to be highlighted is where a survey was undertaken among the distance learners from the open university of the Netherlands. Students from 5 distance learning courses of the university volunteered for it. They were asked to complete 3 surveys. The first survey included 112 students in which there were 76 men and 36 women [6]. The second survey included 51 students in which there were 34 men and 17 women. The final one included 67 students which included 47 men and 20 women [6].

The students were grouped for projects. The project was done in such a way that there were 2 categories: one individual project and 2nd the group project [6]. By all the research work and the survey analysis, it was concluded that working in a group shows better results than working individually. Thus Collaborative learning showed positive and satisfactorily results on students [6]. The group learning had proved to be more effective for the individuals as it gave them an opportunity to interact at a competitive level and gain and share knowledge to get benefitted.

III. PROPOSED DESIGNS
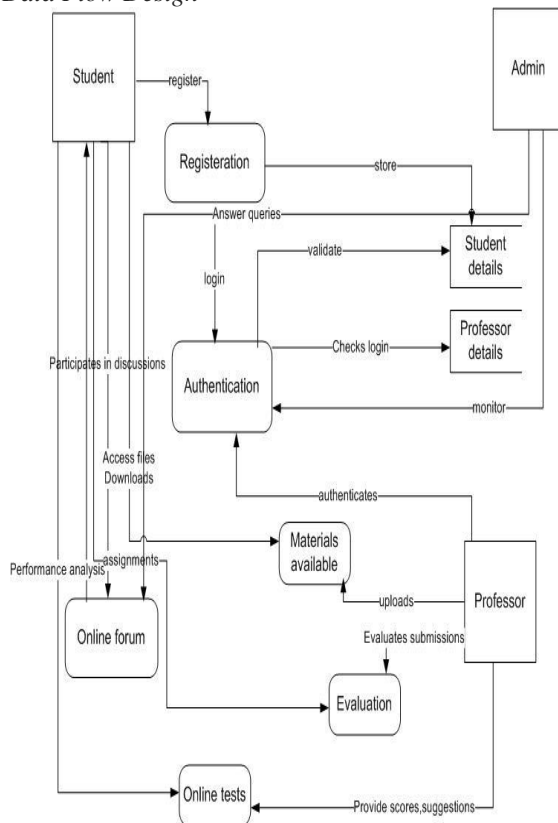
3.1 Data Flow Design

Fig 1: Data Flow Diagram Level 1

3.1.1 Description
The above diagram is the representation of the Collaborative learning systems where the flow of data has been represented as the Data flow diagram.

The proposed system consists of three main roles:-Students, Admin, and professor. The student (learner) registers on the site and then it can undergo the authentication process which is only after registration which will be monitored by the administrator so as to ensure validation of the particular learner. The functionalities available for student includes:-

Online Forums where all the discussions or queries will be taken into account so that the students can engage in debates, discussions among themselves and resolve queries, if any query is related to system constraint then admin holds the accountability to resolve the same. Also, a professor can answer certain queries of students, i.e., anyone can interact with anyone from anywhere. Online Tests are available to students for their performance analysis graph which will constantly be monitored by professor and possible suggestions for improvement will be provided based on scores obtained.

Students may access the materials such as either PowerPoint presentations, Word Documents, Transcripts of lectures or video lectures uploaded by the professor as well as they can submit any query or assignments which need to be evaluated by the professor for better understanding. However, the functionalities require the students to join a particular curriculum under which they would be provided the facilities. This curriculum may be (optional) paid one and can be joined at the time of registration. Separate databases will be maintained for both, students and professors who will need an authentication.

3.2 User Interface Design
The fundamental prototype for authentication for the student:

Requirements: Username and Password, though for registration, the user needs to register by filling his details for creating an account.
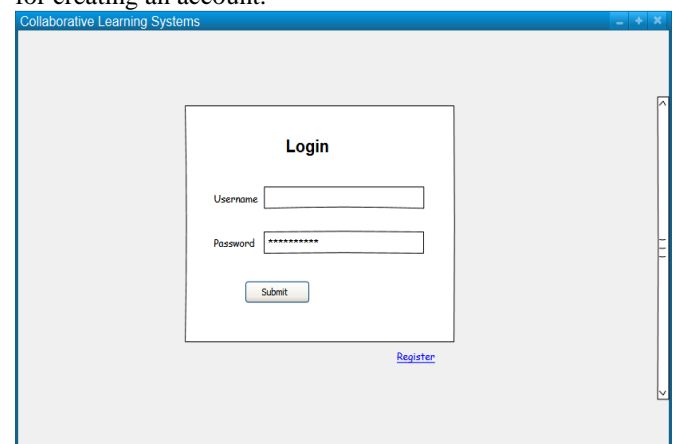

Fig 2: UI Screen 1

After Login: The fundamental prototype of what content the Collaborative learning system would entail,
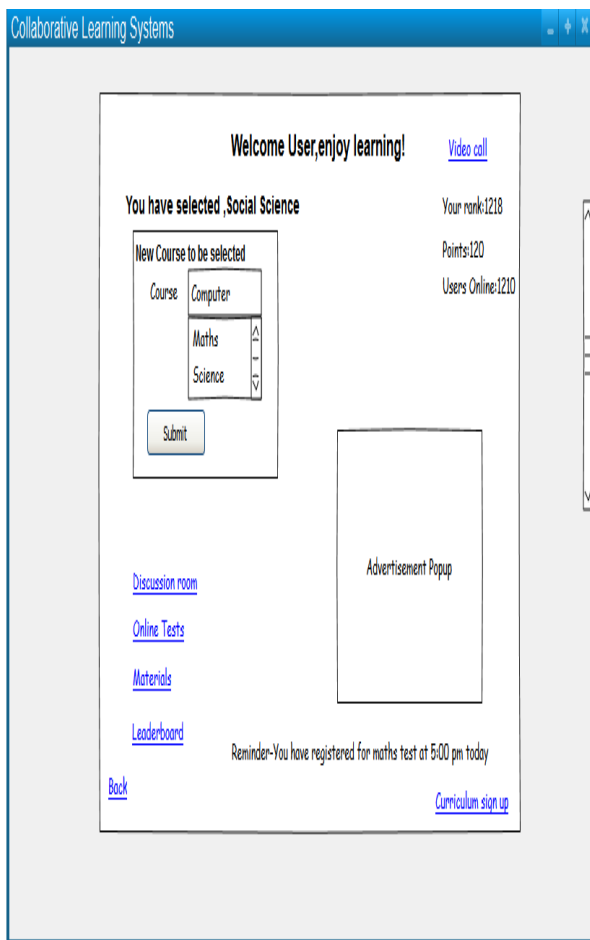
Fig 3: UI Screen 2

3.2.1 Description

The above two are the user interfaces whose fundamental prototypes are represented by the use of content. The first interface is the authentication part and as soon as the authentication is done it will head towards the second part where the homepage will be there. The learner can select any of the courses, he wants, as well as he can ramble into discussion forums, online tests, materials available for that particular course also. The rank and points acquired by the student since he made his account will also be displayed on a certain part of the site. The 'reminder' functionality will make the student aware of any registered online tests, he needs to complete or any approaching assignment deadline.

3.3 Proposed Ideas:

- Also, it will be an advantage if schools provide Collaborative Learning Experience Centers in order to familiarize them with the technology and the tools. This will create a real life experience for the students and make them used to such a system so that they can be more interactive and can gain the most out of it.
- The student needs to be trained in those Experience Centres on how to use the available resources and make them cognizant about the advantages accessible to them. The staff needs to be adequately trained with the required experience so that they can pass the same to the students and professors and make them cognizant about the concept.

- Collaborative learning online platform will be easier to use for the students if they are already a participant of Collaborative Learning Experience Centre.
- The Collaborative Learning should also be encouraged using Social Networking Platforms where the same intensity of being active should be there. It is because social networking is the platform where people are used to sharing ideas, knowledge and posting materials to reach out to other people. Hence if there will be a strong base for Collaborative Learning promotion through the social network, it will outreach to maximum people to make them involved with the concept and enhance productivity.
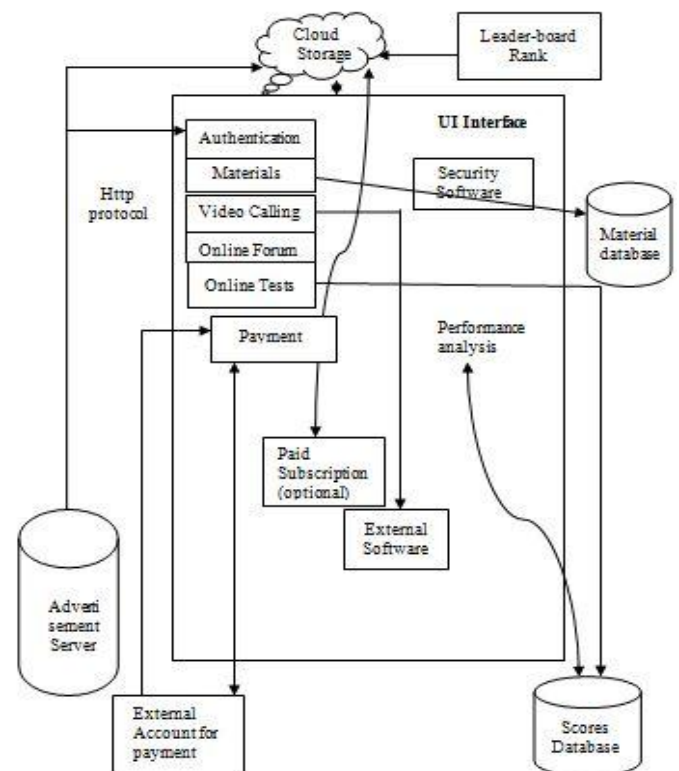
3.4 Architecture Diagram

Fig 4: Architecture diagram

3.4.1 Description

The architecture of Collaborative Learning System consists of the concept of "Cloud Computing" which is a major platform for data storage. In the forum, the data will be accessed through cloud because the amount of data to be held may be dynamic. There are three different servers to be maintained for the student, the professor and an advertisement server.

- There will be an advertisement server which is related to the advertisements display while the student visits the site. It's a marketing strategy which will be beneficial for the companies if they can persuade a higher traffic on the site. This will also act as a medium of sponsorship for implementing a collaborative system which might be expensive in case.
- The authentication will be done by the verification by the servers. If the data of the user is present then it will be a success else it will be a failure. In the system, there will be a database where all the materials related to the

particular course in form of pdf's or docs or video lectures are stored as well as a separate database is to be maintained for the evaluation criteria and comments which will be received after evaluation of assignments or the online tests.

- The data sources are the collection of information from multiple/different sources and will be sent to the learning system.
- For the purpose of video calling, there is no in-built software for the system, they have to use an external software like skype to initiate video calling or conferencing. In addition, there's will be software designed especially for the security of the site to avoid access to unauthorized users. The leader board is a platform for shining students to reserve a place in it. They will be ranked based on their performances and evaluations by the professors with everyone who will be able access or read that data.
- The payment structure is for the additional facilities a learner can possess after joining the 'paid' curriculum. The payment method is online and offline.
- The Performance analysis holds the performance of individual students based on their online test scores, evaluations or assignment scores and thus they are assigned to the leader-board rank. A popular concept called Calibration explains the same, where it's a degree of person's perception of his performance with the actual performance [4] and can be a useful method in performance analysis.

The motive is to facilitate students to interact among themselves through cloud services, accessing important & relevant lectures which they need to learn, give their online tests timely to evaluate their performance analysis. The theme is to gain, exchange knowledge and to learn through the system.

IV. BOTTLENECKS IN BUILDING COLLABORATIVE LEARNING SYSTEM

There are various challenges that the system has:

- Security issues: Although, the encryption algorithm and cryptography mechanisms to be used along with the support of SSL but the system will have a high number of server requests and data flow at a single time, and hence an unauthorized user might get a chance to get through the complex cyber attacks.
- Design constraint: It will have complexity in design since it involves various functionalities in a single system which might require different configurations and it will be a challenge to maintain a huge number of students and professors on the site at the same time. An exorbitant number of servers will be needed to handle the increasing number of request by time. Cloud storage is required to store vast amounts of data generated, and data transfer among users will be a complex process as well.

- Support: If the collaborative learning room which is filled with advanced technological equipment, a technical glitch occurs, then the time needs to recover the glitch based on the trained staff will be a matter of concern. Adequate training needs to be provided to handle issues with the system. If the staff is not adequately trained and aware, it will cause problems for the system. If any equipment goes down, then what will be the downtime? [14] Proper teams need to design the experience center and manage technical systems [14].
- Defining Methodology: In order to manage the new classroom environment, strategising and planning needs to be done in order to create instructional design and defining guidelines to create a well run and dynamic classroom [14].

V. CONCLUSIONS

Thus we have seen how individual learning and collaborative learning are different from each other and how collaborative learning is more beneficial regarding knowledge gained, shared and projected. In recent years the shift towards collaborative learning systems has been very impressive as well as we can say the proposed system will surely benefit the students rather than individual or the isolated learning where the learner get deprived of much useful information or knowledge.

Hence the existence of proposed model of Collaborative Learning Systems will not only provide them a platform to share and gain but also meet the new level of competencies where they may know where they stand in this world and what approaches they need to follow. They can get their queries resolved faster and efficiently. Both the quality and quantity of the query will enhance. More, the number of students will be following the system, the greater will be the gain. The system will integrate all the different learning environments which students had used individually in the past but now they have a platform where they can find everything into one. New near future studies and theories are expected to emerge related to the concept with the help of emerging technology is on the rise which will be very useful for the learners to build a great future in the field of education.

5.1 Scope of future work

Collaborative Learning System holds a significant scope in future to make a profound impact. If students are exposed to collaborative learning, they will be more productive and will learn things efficiently. Hence in future, students need to be encouraged for group learning by keeping norms and ground rules for the same [2]. Before exposing to the Collaborative Learning Online platform, they should be given clear directions on how to work together as a team [2]. The approach towards learning in schools or universities needs to be changed in order to take a big step towards collaborative learning. They should begin thinking about themselves as institutions of acculturation rather than stores of information [5]. Also, colleges need to revise the longstanding assumptions and authority of knowledge [5]. To achieve the same, collaborative learning is the required measure.

The learning will help the students to learn to challenge the status quo by working together to achieve the same rather than doing it individually [13]. It's the new emerging era of the educational industry bolstered by the online learning. Online learning has provided a cost effective and traditional way for the students to learn effectively [15]. Hence to achieve the same, they should be provided with a great experience so that students feel more enthusiastic and invigorating to learn with the new learning environment leaving the traditional bromide environments behind. They should be comfortable in adopting the new environment. Hence they will be more productive and communicative. This opportunity opens up for the people in the educational industry to progress with research on collaborative learning and implement the concept in schools and colleges. Although some schools and colleges are running with the implementation of this concept and have observed a significant improvement in student's performance statistics, the concern is the expansion of the same throughout the world. The scope for collaborative learning centers and providing with the ideas to implement the concept in a better way or through the centers is widely open.

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