The Effectiveness Of Integrating Software Agent In Learning Management System For Analyzing The Learning Style Of The Students

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ABSTRACT: *The significant trend in schools has been to implement student-centered instruction and to look at the relationship between instructional and digital approaches leading the effective learning style for students' performance.*

This research study was about the development of the current Learning Management System by integrating software agent where the main purpose was improving the academic performance of the students. The objectives were 1) Determine the learning management system to integrate artificial intelligent by improving performance of students; 2) Performance evaluation by the different agent of the students; 3) Develop and interact to help the students; and 4) find significant differences between student's performance andin traditional face-to-face lecture. The sampling applied was purposive. The data collection instrument for learning styles were Visual, Social, and Solitary.

Researchers reviewed and determined the data statistically as a quantitative research that involves analyzing thedata to predict probable outcome accurately. Validation of learning styles based on T-Test statistical experimental findings. In software testing to ensure that operation correctly and each component will also be going to test independently using Felder Silverman Learning Style Model (FSLSM), was used supported by Nash-Q Learning for interaction of different learning style. Students may have one learning style or more depending on student result, the set of exams and activity will be based on student learning style. Based on the student performance of different agent was that the result of the time spent and participation frequency were important for determining success in the learning process also enables monitoring of student engagement and reporting of grades.The researchers, concluded that there was evidence showing the significant difference between the agent-based LMS and traditional face-to-face lecture therefore, the level of agent based on LMS related perceptions on the traditional face-to-face lecture is very much significant.

KEYWORDS - *learning style, Felder Silverman learning style model, Nash Q-learning, Solitary, Social, Visual, Software Agent*

I. INTRODUCTION

The emerging information age also increases the need for knowledge workers, but decreases in the use of manual workers. Lifelong learning is the key of success in the modern society, LMS is considered solution to the problem in terms of delivering the resources required. Having this implemented in our education system nowadays, there is still confusion about Learning Management System (LMS) among instructors, students and academic heads. Although most recognize that using LMS has the potential to enhance greatly learning and even their learning experiences at all levels.

JTLMS provide an assessment for students in term of the learning style. While the traditional methods, such as face-to-face lectures are usual way of learning just like being in school or varsity where lecturer or teacher is at the front of the room having breaks and classes at specific times.

This study revealed that the instructor were aware of the students' preferred learning style and an agent that will match their teaching styles to suit the students' preferences learning style.

II.   BACKGROUND OF THE STUDY

The LMS framework utilizes the software agent technology that is proactive, autonomous, flexible, social, and goal-directed behaviors [1]. The agents must be autonomous to be able to perform the majority of their problem solving tasks without the direct intervention of humans or other agents, and must have self-control of their own actions and their own internal state.   It must also be social ability agents to interact with other agents or humans via some kind of Agent Communication Language (ACL) to complete their own problem solving, and lastly, must be responsiveness agents so that to perceive their environment which may be however that a collection of other agents as well as the Internet and a user via graphical interface will change the occurrences respond in a timely fashion The method was described [2].

III. CONCEPTUAL/ THEORETICAL FRAMEWORK

Figure 1 presents the main structure of the LMS that monitors and evaluates thestudents based on their profiles and their interaction with the LMS system. The general components of existing LMS which will have the following sections such as student that interacts with the LMS by submitting or downloading assignments or class materials and other student's activities and actions.Teacher that provides the courses' general information at the beginning of the semester and evaluates students from the LMS, and lastly the LMS system that implements the agent-based technology, analyzes the learners' profiles and sends the evaluation results of each student to the teacher.

IV. SCOPE AND LIMITATION

The proposed system will use an open platform which could easily integrate the needs of each school to innovate the quality of education. There will be a platform for students and instructors. For the students, they can view the certain subjects as well as instructor's lesson,seatwork, activity and exam, from seatwork, the study will assess on the learning style of the student using the three categories such as: Solitary, Social, Visual, of a student in which agent set an activity and exam depend on the learning style of student per module. Seatwork, Activity and Exams are composed of multiple choice questions which they must answer,the agents limitation in regards to the learning style: solitary will have a new module on the outline form, while social learning style link for the forum or chat, and in visual there will be a video explaining the module. The proposed system has its limitation, usage of internet connection since this is a Web Based LMS, which is consider the most important, in addition, the encoding for the final grade of students will be done by instructors.
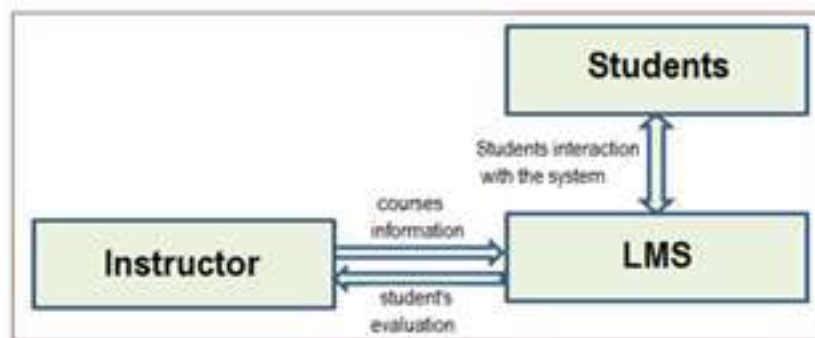

Figure1 Theoretical Framework of Learning Management System

The Research Problem

A study [3] showed multiple studies have shown the relationships between students learning style and on how students learn. JTLMS has agent that will analyse learning style from student and to generate the activity and exam.

This study focus is to combine the LMS with the students determining the learning style of integrating software agent for academic performance.

Specifically, It seeks to solve the following problems:

1. How to integrate artificial agent to LMS to improve performance of students?
2. How to evaluate the performance of student according to the assistance provided by the different agent?
3. How the different learning agent be developed and interact to help the students?
4. Is there a significant difference in using agent based LMS and traditional face-to-face lecture?

V. RELATED WORKS

LMS in education system resulted in a convenience matter in our generation. Technology become more common in our everyday lives, the need for awareness beyond what simple sensors can detect also grows. The behavior of data using the GPS of a mobile can be performed and effortlessly integrate with human is desirable.

Learning Styles

College-bound students continue to expand a multitude of training programs which are now in widespread use in the educational institutions of whatever racial and ethnic backgrounds with differing learning styles.

Learning style as an effective means may become increasingly critical enable to reap the very best through developing a variety of instructional methodologies and technological advances to mold the students as well as faculty members teaches a multi-style fashion as helping the students discovering themselves learn the best for optimum academic achievement

A benchmark definition of learning style is to accept the reflection in the learning environment concerning the application of cognitive, effective, and psychosocial behaviours.

Knowing students' learning styles can help in many ways to enhance learning and teaching. First, teachers can benefit by getting information about how their students are used to learn, which provides them with a deeper understanding and might help when explaining or preparing learning material, furthermore evidence of facilitated-learning in contributing to improve educational outcome in specific ways such as improving access to education and promoting new learning,in addition, students can be supported by [4] supports this theory in matching the teaching style with their learning style.

Several definitions have been offered for the term "learning style.",Study showed defined learning styles as "a description of the attitudes and behaviors which determine an individual's preferred way of learning[5]." Numerous studies refers to several models to classify learning. However, the model cited most frequently with respect to computer-based education systems is that proposed by Richard Felder and Linda Silverman, (FSLSM). A 2008 study (9) showed model identified as the most appropriate for computer-based systems due to its ability to classify learners on the basis of their preferences over four dimensions[6,7,8].

Felder-Silverman Learning Style Model (FSLSM) is considered to be a powerful and reliable model for the computer- based analysis of learners' learning styles,it presents four key dimensions such as the first dimension considers the processing of information preferred by a learner: active (ACT) or reflective (REF),active learners work well in groups, they do not learn much in situations that require them to be passive and tend to be experimentalists,in contrast, reflective learners work better by themselves or with one other person at most, they do not learn much in situations that provide no opportunity to think about the information being presented and tend to be theoreticians.

The second dimension considers the type of information that is preferentially perceived by the learner: sensory or intuitive. Sensory learners prefer to learn facts and like to relate to practical, real-world situations. On the other hand, intuitive learners prefer abstract learning material, such as theories and their underlying meaning. Compared with sensory learners, intuitive learners are more comfortable with symbols.

The third dimension considers the sensory channel through which the external information is most effectively perceived: visual or verbal. Visual learners prefer pictures, diagrams, graphs, or demonstrations, whereas verbal learners prefer spoken information or audio. FSLSM does not consider other sensory channels, such as touch, taste and smell, as these are relatively unimportant in most educational environments [9].

The fourth and final dimension considers how the learner progresses toward understanding: sequential or global. Sequential learners learn in small increments, and therefore have a linear learning progress, tending to follow logical stepwise paths in finding solutions. Conversely, global learners use a holistic thinking progress and learn in large leaps, they tend to absorb learning material almost randomly without viewing connections,however, after learning sufficient material, they suddenly get the entire picture, they can solve complex problems and put things together in novel ways, but find it difficult to explain how they did it.

A study was described in developed adaptive learning environment that each person has a unique way to absorb and process the ability to cope with the environment added adaptive value.   This has an order to achieve the learning courses with variety of learning materials such as learning style of visual, solitary and social which based on the interaction of the multi-agent [10].

Agent

The researchers having accessed to use the agent system database in the developing adaptive learning management systemonto develop the adaptive mash up learning system based on learning style, which has the proposed LMS shown in figure 2.
It presents the proposed LMS which has to motivate the learner and hopefully achieve higher performance in learning as proposed framework adaptively changing course materials in response to the student's learning style.

It shows the system organization that when a student registers for a course on the JTLMS then he/she can access course contents and take exam in JTLMS. All activities performed by the students are stored in the agent system database.
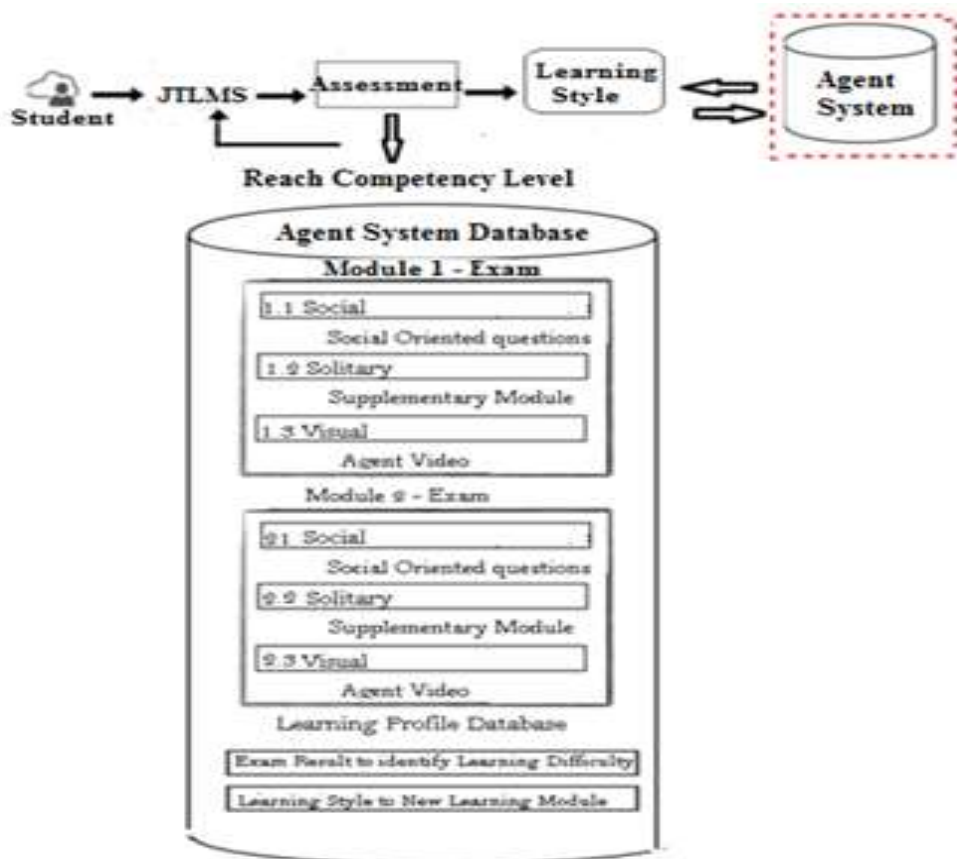

Figure 2 Proposed LMS

In addition, the time expected for the corresponding learning difficulties is estimated, based on new module.

Evaluation

The assessment of students' examination will be added in which, that there will be two sets of module and an exam for each that after the student take the two sets of exam, the agent analyze students learning difficulties. It is somehow the learning style evaluation for individual students based on their experience, learning capability composed of minimum and maximum skills and knowledge being the outcome of the learner.

Evaluation of learning management system is a process that critically examines a learning environment. It purely involves analyzing information about learners' activities such of those modules and outcomes which the purpose is the judgment about the multi-agent to improve its effectiveness.

The published dissertation showed using LMS for National Institutes of Health (NIH) grant proposal that twenty-one groups equivalent eighty-two students voluntarily elected peer-to-peer messages within the LMS, event logs, online surveys, focus group interviews, and instructor interviews were used in order to answer the study's overarching research question of what types of Peer Interactions Between Students Take Place Within LMS [11].

The assessment in the findings of the students for LMS to complete their mock discussed the project in a variety of different ways.

Thestudents learning style may be characterized such as 1) Visual basic interaction, or any kind of communication that takes place online within a LMS tool student will get the three learning style, 2) Social collaboration student peer that shares idea of a group mind these can be obtain through observation learning or watching others behavior, or 3) Solitary knowledge construction, collaboration within a LMS tool between

students when new information is transferred and retained from one student to another or a new understanding is elicited by students through their collaborative interactions.

Learning Performance

Incomparing the JTLMS from the traditional systemsfound that in a single neat package upgrades the performance of the learner. Learning content drives which in turn behaviour change with knowledge retention and academic capability.

The learning intervention to JTLMS were combination of formal/informal and/or social; Learner Engagement such as classroom plus on-demand learning via web or mobile: anytime, anywhere, and on any device; End User Tools such as browse catalog, faceted Search, learning Paths, learner/teacher dashboards, and ratings and reviews; Content Management such as online collaboration, versioning, workflow, and review tools; Content Publishing such as responsive web (HTML5/CSS3), and mobile output templates/formats; Course Administration such as learning paths, classroom management, and competency management; Reporting and Analytics such as, completion tracking, test scores, question analytics, social learning activities and content effectiveness

VI. METHODOLOGY

The researchers were used qualitative both descriptive and experimental research for the study since the method focuses on fact-findings and the interpretation of the gathered data with the use of survey questionnaires and observations and testing capability.
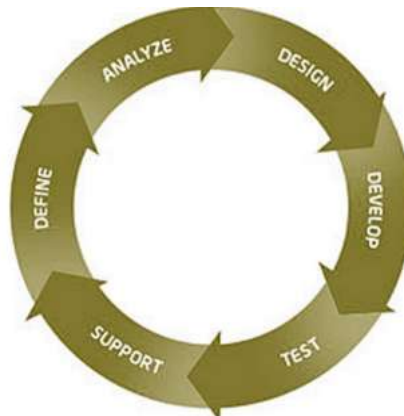

Figure 3 Rapid Application Model

The figure above shows the Rapid Application Development. This is a software development methodology uses minimal planning in favor of rapid prototyping. A prototype is a working model that is efficiency equivalent to a component of the proposed system and these are the following:

Define. The researcherswill use unstructured interview technique to obtain the information from the expert and college instructor about the content and features undertakings, the findings will be used to be the reference for the proposed system.

Analyze. The researcherswill be going to analyze and identify all requirements needed for developing the design by combining all suggestions from the target

.   The results will be converted to a template, which the LMS will use to generate software agent.

Design.   This phase describes the desired features and operations in detail, including screen layouts, user-interface design and application design.

The figure below shows the steps followed in the system design phase:

Figure 4 System Design Phase

Layout design. It is related to the cognitive arrangement of different programming languages that convey viewers' adequately.

User-interface design. This is critical to the program in terms of the suitability and usability for the users. The design and evaluation process involves user interaction at every activity such as quizzes, laboratory works, exercises, and examination

Application design. Determine how finish program works. IT describes the flow of the functions and data structure used in the proposed system

Develop. The actual code/program will be written using Canvass programming language to develop the entire modules.   In this phase, the researchers will try to make the software design to the actual code, this will be converting the layout design and use in interface design to canvass code via Internet for visual view, thus the researchers will have to finish compilation.

Test. The researchers will use software testing environment to check for errors, bugs, and inter-operability using general test procedure for unit testing, such that individual components will be to test to ensure that operation correctly and each component will also be test independently, without other components.

Students Learning Style by FSLSM

Table 1 Learning Style of the Students Based on FSLSM

Learning Style	Relevant Behavior	Intuitive	Attribute
Solitary	Prefers overview, outlines. Prefers to learn in large leaps by skipping learning material & jumping to more complex materials (non-liner way)	Prefers discovering possibilities and relationships, grasping new concepts/abstractions like innovation/dislike repetition.	Seatwork, Quizzes and Exam
Visual	Prefers learning materials supplemented with pictures, diagrams, graphs. Prefers learning materials presented in a video presentation.	Pictures, diagrams, flowcharts, time lines, films, and demonstrations. Written and spoken explanation.	
Social	Passively participates in forum and frequently reading post but rarely posts by themselves. Prefers learning material presented in text or audio.	Need the big picture of a subject before mastering details. How the material being presented relates to the prior knowledge and experience.	

The method in experimenting similarly of number learning objects visited by the student is compared with the total learning objects of the course. This has a form of ratio visits for the given learning style which equivalent to the summation of learning objects visited, all over the summation of learning objects of the course. Take note that the average ratio for each learning style is determined by the average of ratio of time and ratio visits that can be used to express whether a learner has a weak, moderate, or strong preference for the selected learning style or can be analyzed and measured the outcome as low and/or high respectively.

The table 1 presents the features of mapping according to the relevant behaviors and navigational patterns of the student based from Felder-Silverman Learning Style Model. These sets of relevant behaviours are extracted from JTLMS database to construct the data sets and define the features that can be extracted.

It provides the list of learning style mapping of relevant student's behavior on learning styles, the student's behavior are presented through their relevant interaction in JTLMS.

Support.   The researchers will use references such as books and other materials for activities such as quizzes, laboratory exercises and/or examination that support the system. It must have to use the Nash-Q Learning that there is much number of times that Nash-Q Learning makes a goal simultaneously than Q-Learning. Because the Q-Learning agents consider only the profit of own, they cannot avoid other agents,

while Nash-Q Learning agents accumulate the action history of other agents, so they can make mutual concessions.

Nash-Q Learning Tools
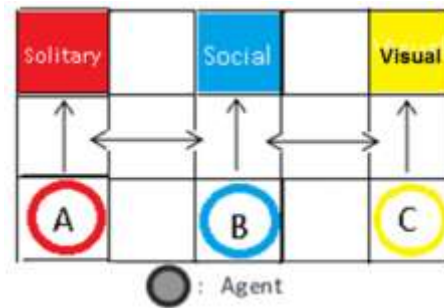
Figure 5 Interaction of Learning Style

Figure 5 shows the analysis after the seatwork agent to analyse student learning style. The student can have one or more agent depend on the result, after determining the learning style the following activity and exam of the student will be the basis on student learning style.

The researchers were also used statistical treatment of data treated that involves analyzing the data on how it will be presented using the following equations to predict probable outcome accurately

Arithmetic Mean uses the formula:

$$\bar{X} = \frac{\sum x}{n}$$

$\sum$= represents the summation
X= represents total of frequency
n= represents number of respondents

T –Test

The researchers will use a t-test for analyzing the significant difference of the agent-based LMS, and traditional face-to-face lecture. This has to compare both functionality through statistical examination of variances of two normal distributions are not known.

Formula:

$$t = \frac{(\sum D)/N}{\sqrt{\frac{\sum D^2 - \frac{(\sum D)^2}{N}}{(N-1)(N)}}}$$

where: $\sum D$ = Sum of the differences
  $\sum D^2$ = Sum of the squared differences
  $(\sum D)^2$ = Sum of the differences
  N = Degree of freedom

VII. RESULTS

These findings were answered the research questions which were analyzed to identify, describe and explore the effectiveness of integrating software agent for the academic performance.

Integrate artificial agent.

Theintegration artificial agent for the improvement of students' performance was confirming the understanding degree using the JTLMS, this can transmit the knowledge of the students effectively. After the assessment particularly the module is finished, the student can review and read the content as competency level anytime, in which to determine what learning style should be necessaryin understandingthe module. The formation of the examination schedule can be done automatically,it they finished to answer it and the agent carry out open review as considered discussion based on the results outcome. Take note that agent system must have the style of social, solitary and visual capable to student comprehend, to increase and can keep fixed progress speed of the lecture with given algorithm below.

```
Algorithm
1. begin
2. for i = 0 to n do
3. for each incorrect_answeria with q[i] in exam do
4. if ia is under solitary then
5. insert q[i] in solitary
6. else if ia is under social then
7. insert q[i] in social
8. else if ia is under visual then
9. insert q[i] in visual
10. end if
11. for j = 0 to t do
12. Find frequency answered_questionaq of questions
13. for each question_typein LIST
14. Calculate
15. current_rank[j]=question_rank[j] + (aq * criteria)
16. end for
17.       end for
18. if criteriacontains 1 or more then
19. For k=0 to 1 do
20.       FindMin question_rank[k]
21.         exam_rank[k] = exam_rank[k] + question_rank [k
22.           end for
23.           end if
24.           end for
25.         End for
26. Rank the result according to their exam_rank score
27. end
```

Figure 6 Algorithm of the system

Figure 6 shows the algorithm of the system, and how the agent that will classify the three learning style such as Social, Visual and Solitary.

Table 2 shows the performance of student according to the assistance provided by the different agent

      The goal to confirm student's performance can be measured and analyzed according their learning style based on the given outcome.   The prominent learning style among the performance of the students is social which means that group dynamic has superficial effect with effective manner followed by solitary and visual simultaneously with analyzing perhaps that during the video spent that has already the time of exploring their thinking views.

Evaluate the performance of student according to the assistance provided by the different agent.

Table 2 Performance of the Student
According to the Assistance Provided by the Different Agent

No.	Student	Test Result	Solitary	Social	Visual
1	student	13/15	86.67%	87.50%	100.00%	50.00%
2	student	0/15	0.00%	0.00%	0.00%	0.00%
3	student1	2/15	13.33%	11.11%	33.33%	0.00%
4	student	0/15	0.00%	0.00%	0.00%	0.00%
5	student1	6/15	40.00%	28.57%	25.00%	75.00%
6	student1	3/15	20.00%	30.00%	0.00%	0.00%
7	Andrea	13/15	86.67%	88.89%	75.00%	100.00%
8	Andrea	15/15	100.00%	100.00%	100.00%	100.00%
9	Mendoza	12/15	80.00%	87.50%	75.00%	66.67%
10	casinto	14/15	93.33%	90.91%	100.00%	100.00%
11	casinto	10/15	66.67%	62.50%	100.00%	66.67%
12	Mendoza	7/15	46.67%	50.00%	66.67%	0.00%

1 3	reymer	0/15	0.00%	0.00%	0.00%	0.00%
1 4	reymer	0/15	0.00%	0.00%	0.00%	0.00%
1 5	Mendoz a	4/15	26.67%	0.00%	0.00%	57.14%

Different learning agent be developed and interact to help the students.

User	Score	Learning Style
student	13/15	solitary, social
student	0/15	
student1	2/15	
student	0/15	
student1	6/15	Visual
student1	3/15	solitary, social,visual
Andrea	13/15	solitary, social,visual
Andrea	15/15	solitary, social,visual
Mendoza	12/15	solitary, social,visual
casinto	14/15	solitary, social,visual
casinto	10/15	solitary, social,visual
Mendoza	7/15	Social
Reymer	0/15	
Reymer	0/15	
Mendoza	4/15	Visual

Figure 7 list of students and their learning agent

Figure 7 shows the list of students and module corresponds with scores of each exam of the student, which are recorded on the database, exam3 was based on student learning style.

Based on Nash-Q Learning tool, one factor that certainly impacts agent learning is their self-regulation skills for interaction, that is, the capability to know their own abilities and academic skills,and to use them in order to stay focused to achieve a particular goal. Different learning agent has desirable goal of students, in addition to performing learning activities, maintain a sense of self-efficacy to learn, assess their own learning, and keep the belief that they will get positive results, maintaining a positive attitude and enjoying what they are doing. A theorysuggests that the process for classifying, and assessing progress in the categories of self-regulation of a student in a diagnostic process that can evolve according to their performance.The theories share a common ground where self-regulation is composed of different aspects such as monitoring, goals setting, etc.in addition to being cyclical, such involving the interaction of personal, behavioral and environmental factors that change during the learning process, those components can be supervised to lead, to desirable changes in strategies, cognitions, emotions and behaviors of different agents[12].

Significant differences between student's performance and in traditional face-to-face lecture.

Table 3 Paired T-test for Pre and Post Test

		Mean	SD	t
Solitary	Pre	3.50	0.62	**3.69**
	Post	2.61	0.98	
Social	Pre	2.83	1.15	**3.22**
	Post	2.00	1.19	
Visual	Pre	3.11	0.96	**2.61**
	Post	2.33	1.08	
Total	Pre	18.50	3.47	**4.91**
	Post	14.94	4.45	

Table 3shows the significant difference between the agent based LMS and traditional face-to-face lecture showing is presented. To find whether or not there is variations on the level of using LMS and traditional one for learning capability, the statistical declaration is to accept the null hypothesis.

VIII.   CONCLUSION

The researchers were drawn with the following recommendations based on the aforementioned findings:

1. The integration artificial agent to LMS, to improve performance of students, stand out that integrated tool and its components are useful for supporting collaborative learning in a variety of courses.
2. The evaluation of students' performance, according to the assistance provided by the different agent was that the result of the time spent and participation frequency were important for determining success in the learning process.
3. Responses, respondents on the different learning agent be developed and interact to help the students were LMS provides a range of learner activity options, such as forums, databases, and wikis; facilitates student assignments, quizzes, and enables monitoring of student engagement and reporting of grades
4. The significant difference between the agent based LMS and traditional face-to-face lecture accepted, the researchers concluded that there was evidence showing the significant difference, between the agent-based LMS and traditional face-to-face lecture. Therefore, the level of agent based on LMS perceptions on the traditional face-to-face lecture is very much significant.

RECOMMENDATION

Based on the foregoing conclusions, the researchers was drawn the following recommendations:

1. It must have a further review and studies about the learning style in such a way to expound more knowledge and skills for upgrading.
2. The full implementation of the proposed system to the college students especially for those who are in the remote areas.
3. Encourage college and university instructors to enhance the proposed system regularly especially for major courses.
4. Recognize the new LMS to all instructors to utilize during their class time schedule as well as the administrator to provide their time enhancing the proposed system.
5. It is also to recommend that research bemade by spreading out to all department or colleges so that the whole campus must have a standard learning management system.

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