Intelligent system of advisable learning time in e-learning platform

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Abstract— For years e-learning has proven its success in providing a diversified and personalized content. Learners have always been motivated and satisfied to be able to consult different online courses without time or space constraints. As a result, they can spend a lot of time in front of the computer screen without being aware that it can affect their eye and body health. It is therefore not surprising that computer vision syndrome has become an important occupational health issue. These problems may include physical fatigue, decreased productivity and increased number of learning errors. To ensure learners' ideal time learning on a computer screen, our work aims to integrate a healthy intelligent agent in learning platforms.

In order to preserve learners from computer vision syndrome, we have an innovative idea to develop an intelligent agents' system that will remind learners every 20 minutes to look far away for 20 seconds in accordance to the 20-20-20 rule. We are interested in particular to develop an intelligent agents system, which is a set of agents that interact with each other and give proposition to learners to take a break every two hours. The system measures learning time and compares it to the advisable time learning on a computer screen, then it proposes to learner to take a break and keeps track of his arrest point on the lesson.

Index Terms— time learning, ideal time learning, computer vision syndrome, 20-20-20 rule, digital eye strain, screen fatigue, time screen in e-learning

1. Introduction

For years e-learning has proven its success in providing a diversified and personalized content. Learners have always been motivated and satisfied to be able to consult different online courses without constraints. As a result, they can spend a lot of time in front of the computer screen without being aware that it can affect their health.
Actually, in e-learning we spend a lot of time in front of a computer screen which causes eye and body fatigue. It is therefore not surprising that computer vision syndrome has become an important occupational health issue. Studies show that eye strain and other annoying visual symptoms occur in between 50% and 90% of workers who use the computer (Heiting and Wan, 2017).

The fatigue associated with screen work is directly proportional to the time spent in front of the console but also to the quality of the observer's vision. Scientists recommend people to take frequent breaks to look at faraway objects during screen time significantly lessened their eye strain symptoms. These problems may include physical fatigue, decreased productivity, and an increased number of learning errors. Dry eye is intimately related to CVS as either cause or effect (Rossignol and al., 1987). But they can also include minor troubles such as a flicker of the eyelid and red eyes.
All of these problems lead in most cases to a significant proportion of dropouts. We can say that the existence of a healthy intelligent agent in e-learning platforms is an important asset in the preservation of learners' health. Our work aims to provide an intelligent agents system that will help students learn in good health condition.
The paper is organized as follows; section II is a presentation of time learning on screen, the problems caused by and the preventive measures such as rules to take in consideration. Section IV gives an idea about the Multi Agents system. Section V explains the approach of learning duration detection system. The last section explains the implementation of the system.

2. Time Learning On Screen: Problems And Preventive Measures

2.1 Health problems related to learning on screen

Computers have become an indispensable part of modern life. Working for long hours in front of the computer is no longer confined to the office. Computers are now extensively used in schools and at home as well. With increased popularity of use of digital display devices for work, study and web surfing. These accoutrements of modern living may give rise to a number of visual and ophthalmic problems collectively called the Computer Vision Syndrome (CVS) (Rimli, 2013).
Computer Vision Syndrome, also referred to as Digital Eye Strain, describes a group of eye and vision-related problems that result from prolonged computer, tablet, e-reader and cell phone use. Many individuals experience eye discomfort and vision problems when viewing digital screens for extended periods. The level of discomfort appears to increase with the amount of digital screen use [4].
An increasing use of devices with display screens at all ages is beginning to make computer vision syndrome an important public health problem. This problem affects both the eye health and job performance (Akkaya and al., 2018)
The American Academy of Ophthalmology explains that looking at digital devices won't necessarily damage your eyesight. But it can cause strain and unpleasant symptoms. Focusing too much while looking at the computer screen causes less blinking, this can cause uneven distribution of tear film over eye causing dry eye. Although screen glare and character size don't affect blink rate, studies have shown that a visual de-

manding computer work can decrease the blink rate from 24 to 5 blinks per minute (Helland and al., 2007).
In a study published by the Nepalese Journal of Ophthalmology, researchers examined computer use and its effects on the eyes of university students in Malaysia. Almost 90 percent of the 795 students had symptoms of CVS after just two continuous hours of computer usage as shown on the table below (Reddy and al., 2013).

TABLE 1: MOST DISTURBING SYMPTOMS FOLLOWING COMPUTER USAGE IN MALE AND FEMALE STUDENTS BY (REDDY AND AL., 2013)

Symptom	Male	Female	Total	Percent
Headache	57	100	157	19.7%
Eye strain	51	79	130	16.4%
Dry eye	32	76	108	13.6%
Blurred vision	38	43	81	10.2%
Neck pain	36	43	79	9.9%
Backache	18	36	54	6.8%
Shoulder pain	7	34	41	5.2%
Watery eye	18	16	34	4.3%
Red eye	10	9	19	2.4%
Discomfort	4	5	9	1.1%
Double vision	1	2	3	0.3%
No symptoms	41	39	80	10.1%
Total	313	482	795	100.0%

Also, 90% of the 70 million U.S. workers using computers for more than 3 hours per day experience CVS in some form (Blehm and al., 2005).
Long hours of computer use, poor lighting in work place, glare on the computer screen, improper viewing distances, poor seating posture, inadvertent less blinking, CVS and/or uncorrected vision problems are combination of these factors (Hazarika and Singh, 2014).
Words and images on computer screens are created by combinations of tiny points of light called pixels, which are brightest at the center and lessen in intensity toward the edges, making it difficult for the human eye to maintain focus (Heiting and Wan, 2017).
In fact, wellbeing peaked at 4 hours and 17 minutes of screen use (computer, TV, smartphones …) a day.

2.2 Screen fatigue

The fatigue associated with screen work is directly proportional to the time spent in front of the console but also to the quality of the observer's vision and his age. This sensation can take many forms:
Visual fatigue: This is the most common phenomenon with the feeling of not being as good in terms of vision as intellectually. Visual fatigue involves a set of symptoms of visual and ocular discomfort causing a reduction in the functional capacity of the visual system (Cail, 2017). It is rarely a decrease in sharpness, but more often a binocular imbalance with impressions of images that split or become blurred.
Ocular fatigue: There is a large number of objective and subjective signs for visual fatigue, such as dried mucus of the eyes, tears around the eyelid, changes in blinking rate (Jaschinski and al., 1996) and reduction of the speed of eye movements (Saito, 1992; Chi and Lin, 1998) to cite only a few of them. Researchers particularly focused their efforts on the near vision triad (accommodation, vergence and pupillary response).
Cognitive fatigue: While visual fatigue manifests itself through ocular disorders, it also induces cerebral and psychological disorders such as headache (Ando and al., 2002). The observations tend to demonstrate that visual fatigue also affects cognitive processes from the human visual system (HVS) (Urvoy and al., 2013).
Eye strain: Itchy eyes, irritations, dry eye sensations. These characteristic signs are related to an insufficiency of lacrimal secretion particularly badly lived. Normally, the frequency of blinking is of the order of 12 to 20 per minute, allowing the formation of a new tear film before breaking the previous one. But screen work is associated with a decrease in this frequency and therefore drying of the surface of the eyes (Prabhasawat and al., 2019).
General strain: Amongst the large set of assessed symptoms, some of them proved to be particularly significative: ocular pain and irritation, dry eyes, double vision, blurry vision and focusing difficulty, nausea and headache and head and neck pain can also be added (Urvoy and al., 2013; Munshi and al., 2017).

2.3 Common preventive measures

As cited in the previous paragraph staring on computer screen for a long time can lead to a variety of eye problems. Taking the necessary preventive measures and early steps can go a long way towards alleviating these symptoms.

- Changing activity:

A continuous activity on screen is not desirable for a whole day's work. Thus, any screen work with a daily duration longer than 4 hours should be alternated with other activities. By changing activity, the alternation of the work on screen with for example tasks on paper, it allows to diversify the solicitations and thus to reduce the risk of visual and postural fatigue (Cail, 2017).
A change of activity (or moments of non-fixation of the screen) must occur either 5 minutes for 45 minutes of work, or 15 minutes every 2 hours according to experts. The American Optometric Association suggests a break of 15 minutes after 2 hours of continuous computer use (Rimli, 2013).
Workers should also rest their eyes when using the computer for prolonged periods. After 2 hours of continuous computer use, individuals should rest their eyes for 15 minutes. Employees should also be encouraged to have regular eye examinations to maintain visual health and prevent CVS (Randolph, 2017).

- The 20-20-20 rule

The American Optometric Association defines computer vision syndrome as a group of eye and vision-related problems that occur due to prolonged computer usage. The ocular discomfort appears to increase with the amount of computer usage. Up to 90% of computer users may experience visual symptoms like blurred vision, eyestrain, headaches, ocular discomfort, dry eye and diplopia (Thomson, 1998).
While many doctors suggest the 20-20-20 rule is a best line of

defense, researchers explain that any break from repetitive computer work or screens is beneficial. After every 20 minutes of computer viewing, one should take a break for 20 seconds to allow the eyes to refocus (Rimli, 2013).
To reduce the effects of visual fatigue the American Optometric Association recommend following the 20-20-20 rule, take a 20-second break to view something 20 feet (just over 6 meters) away every 20 minutes [4]. This will minimize the effects of visual fatigue that occur when a screen is placed too close for too long. Although it is clear that computer screens can cause eyestrain, there is no evidence that they damage the eyes in the long term.

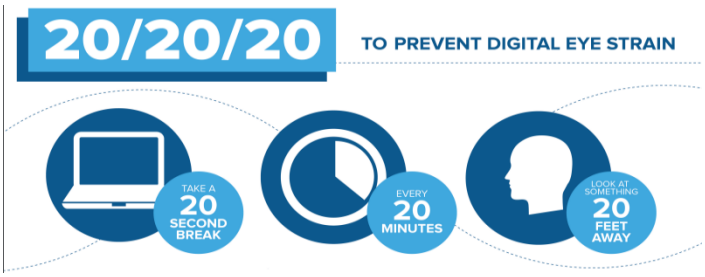


FIGURE 1: 20-20-20 RULE (AMERICAN OPTOMETRIC ASSOCIATION)

It takes about 20 seconds for your eyes to completely relax, time to get up and drink water to keep body hydration. If the body is hydrated, eyes will be as well.

3. MULTI AGENTS SYSTEM

Multi-agent software is built on the image we have of the functioning of a society of humans: several components (called agents) each perform a specific task, interact and communicate with each other to ensure consistency, completeness and correction of a global activity. Like any society of humans, agents will be able to reorganize themselves and adapt their behavior to changes in the environment (learning concept).

3.1 Definition of intelligent agent

An intelligent agent is defined by EL-Zaher et al, (2016) as "An agent is an autonomous entity that can represent a process, a robot, a human, etc. The behavior of an agent is specified according to its perceptions and interactions."

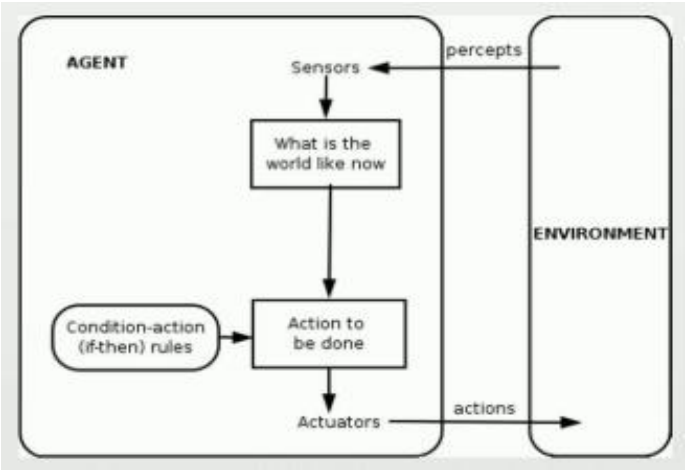


FIGURE 2: INTELLIGENT AGENT ARCHITECTURE BY (EL-ZAHER AND AL., 2016)

Intelligent agents are used when designating systems that operate in an environment that is constantly evolving in which agents use their sensors to percept environment changes and act according to it.
Ferber (1999) defines an agent as a physical or virtual entity that:
is able to act in his environment
can communicate with other agents
is endowed with autonomy and is driven by a set of tendencies (individual objectives)
is able to perceive his environment and adapt to his modifications
….

3.2 Multi agents systems definition

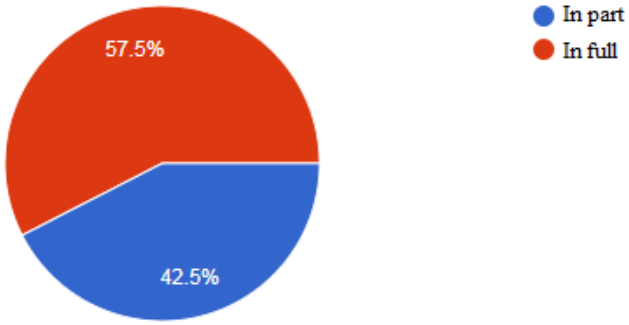
A Multi-Agent System is often defined as a set of agents that interact in a common environment. Ferber (1999) has defined two types of agents: reactive agents and cognitive agents. Reactive agents are rather instinctual. In general, they respond to environmental stimuli. Their behaviors are guided by the local state of the environment in which they are located. Cognitive agents are able to reason. They are considered rational agents and their actions follow a principle of rationality in relation to the goals that direct them. Cognitive agents can also negotiate with each other to perform a given task.
It is easy to see that the definition of an agent is that of a living organism whose behavior, which consists in communicating, acting and eventually reproducing, aims at satisfying its needs and objectives from all the elements they have [20].

4. APPROACH OF ADVISABLE LEARNING TIME DETECTION

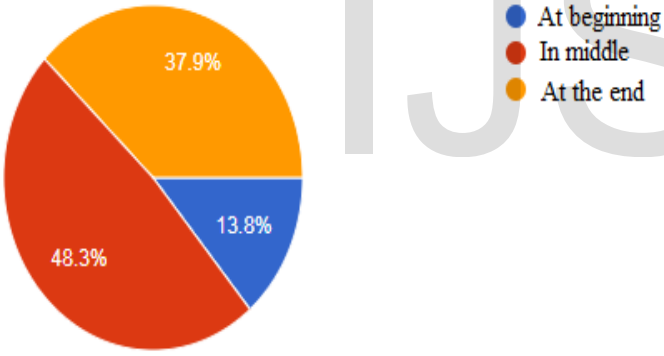
4.1 Observationnal study

We conducted a survey to License and Master students from different departments at Moulay Ismail University, given their daily computer use over a significant duration. The purpose of the survey is to measure the need for an intelligent agents system to protect the students' health and preserve their eyes, as shown by the responses of the majority of students who have liked the integration of a healthy agent in e-learning platform. Among the prominent questions and responses of the survey we mention:

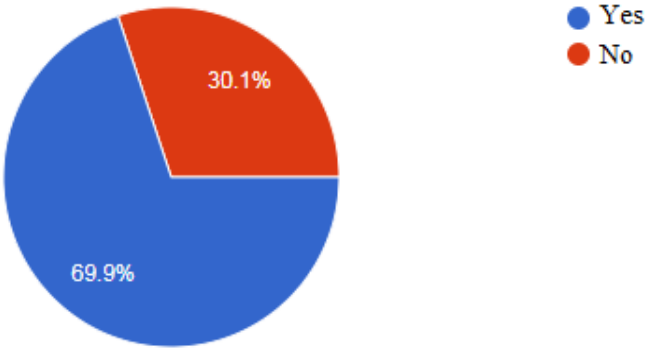
Usually, do you read the course in part or in full?



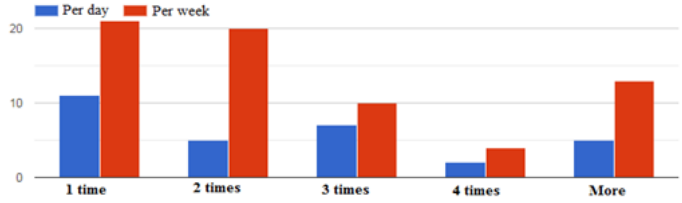
If you read the course in part, what level do you stop at?



If the duration of the course exceeds the advisable time that a student can spend on computer screen, what would you say if you were asked to read the course summary and quit in order to come back later to complete it?



What is your frequency of using the e-learning faculty platform?



The responses show that 57.5% of students read the course in full with a high frequency of the platform use exceeding 1 time per day, which means that they spend several time on screen. Following the same survey 69.9% of students agreed with the proposition of integrating the health agent to the e-learning faculty platform.

4.2 Advisable learning time system

Actually, learners get absorbed in reading or working on screens. Setting a timed reminder to pop up can help them to take a break every 20 minutes. There are also free apps that remind people to take a break. In order to preserve learners from computer vision syndrome, we have an innovative idea to develop an intelligent agents' system that will remind learners every 20 minutes to look far away for 20 seconds in accordance to the 20-20-20 rule. As shown in the following schema.

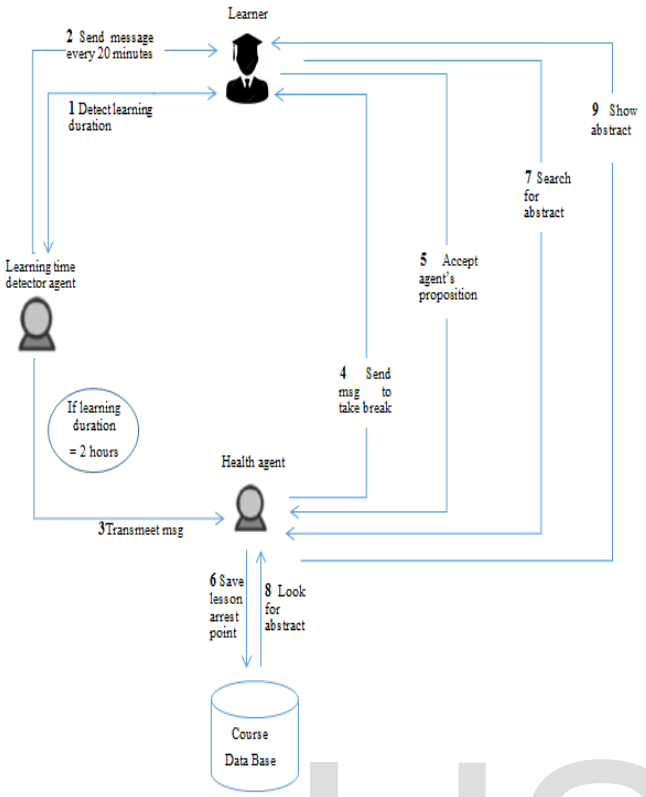


FIGURE 3 : ADVISABLE LEARNING TIME DETECTION SYSTEM

The first agent will send a message every 20 minutes to the learner to look far away for 20 seconds, also he calculates the learning duration and compares it with the advisable time that a learner can spend on screen which is 2 hours, if he detects that it exceeds it he communicates with the second agent who is responsible for sending a message to the learner advising him to take a break and propose to him to read the abstract and return later to the platform to continue his learning activity, the agent keeps track of the learner's course breakpoint. The diagram in figure 2 explains the intelligent agents' system approach.

Agents activity diagram

The activity diagram is an important diagram in UML to describe the dynamic aspects of the system. The activity diagram is basically a flowchart to represent the flow from one activity to another activity. The control flow is drawn from one operation to another. This flow can be sequential, branched, or concurrent. Activity diagrams uses different elements such as fork, join,…

The following schema shows the activity diagram of the intelligent agents system, it contains two agents that interacts with each other and react with learners.

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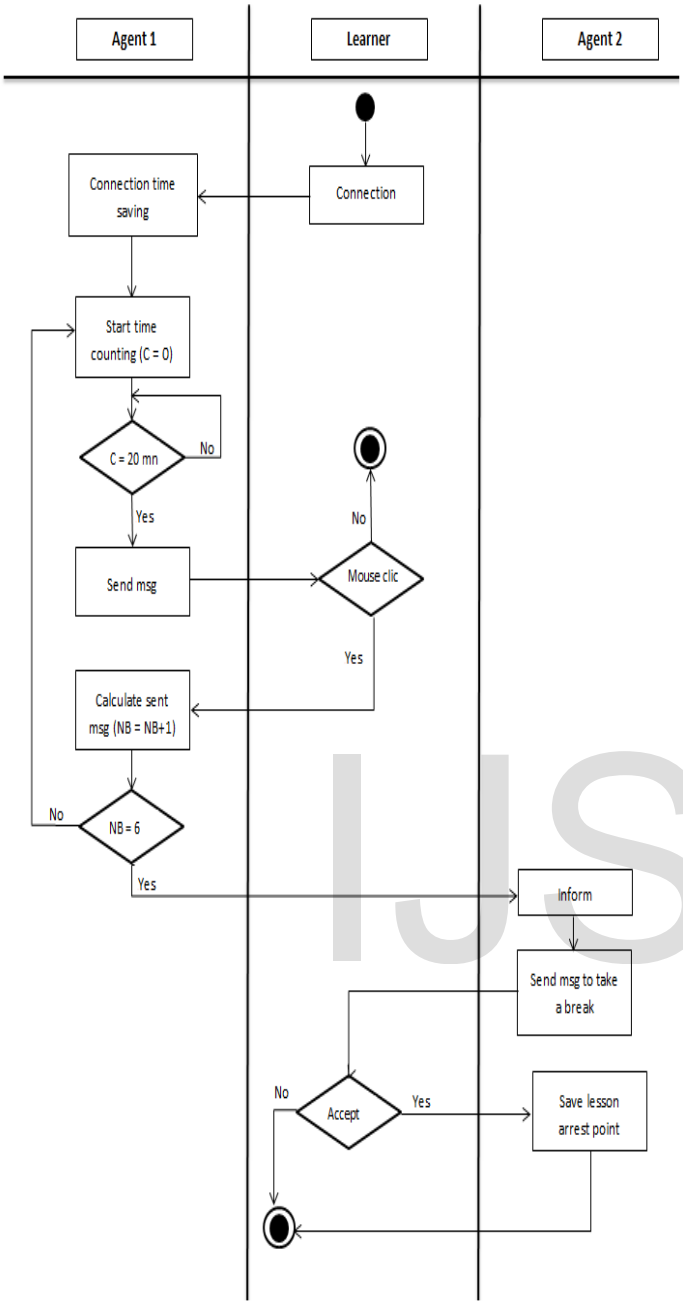

FIGURE 4 : SYSTEM'S ACTIVITY DIAGRAM

When a learner connects to the platform, the first agent logs his login time. After every 20 minutes the agent begins to send a message to him to take a rest of 20 seconds by looking at an object far from 20 according to the 20-20-20 rule.

The learner has the right to decline the message sent by the agent, in this case the agent stops. Otherwise if he clicks ok, the agent increments the number of messages sent, if this number is equal to 6 messages this says that the connection time of the learner is 2 hours. In this case the second agent intervenes to ask the learner to take a few minutes rest and return later, while keeping track of his lesson arrest point.

5. IMPLEMENTATION

In recent years, eye diseases have spread a lot among computer users, for what we came up with the idea of designing a multi-agent system for the detection of the advisable time for a learner in an e-learning platform.

In order to validate our proposal, we integrated it with the e-learning platform of the Faculty of Arts and Humanities at Moulay Ismail University. It can be accessed at the following link https://www.elearning-faculty.com/moodle/. We made experience with learners of License and Master as part of additional training on different specialties.

The home page is presented in the figure 8:

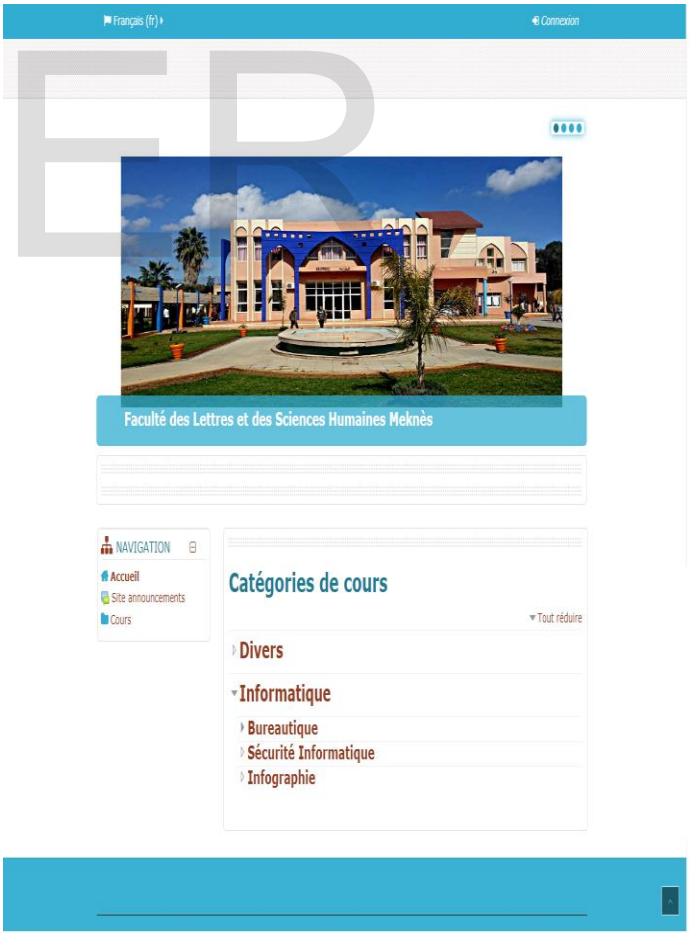

FIGURE 5: E-LEARNING PLATFORM HOME PAGE

We made the test on Master and License students pursuing training in office automation more precisely in Excel. The following figure shows the course unit tree with the associated exercises.

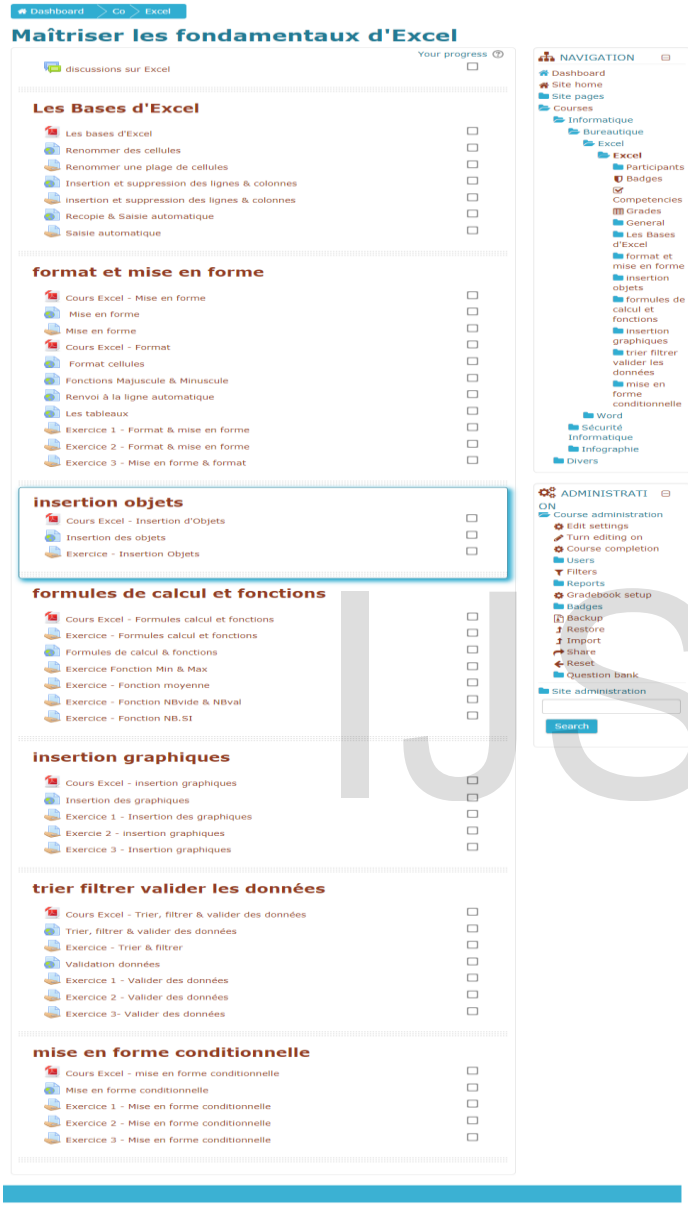

FIGURE 6 : COURSE UNITS' TREE

The previous figure shows the 7 units composing the course, starting with the basics of Excel and arriving at the conditional formatting. Each course unit contains a course material in the form of a pdf file, an explanatory video and application exercises.

The 20 minutes message appeared on the platform as shown by the figure below:

FIGURE 7: THE 20 MINUTES MESSAGE

The learner can accept the agent message as he can decline the message, in this case the program stops. If he clicks the ok button, the program shows other messages every 20 minutes and after 2 hours the second agent shows the message in the figure below:

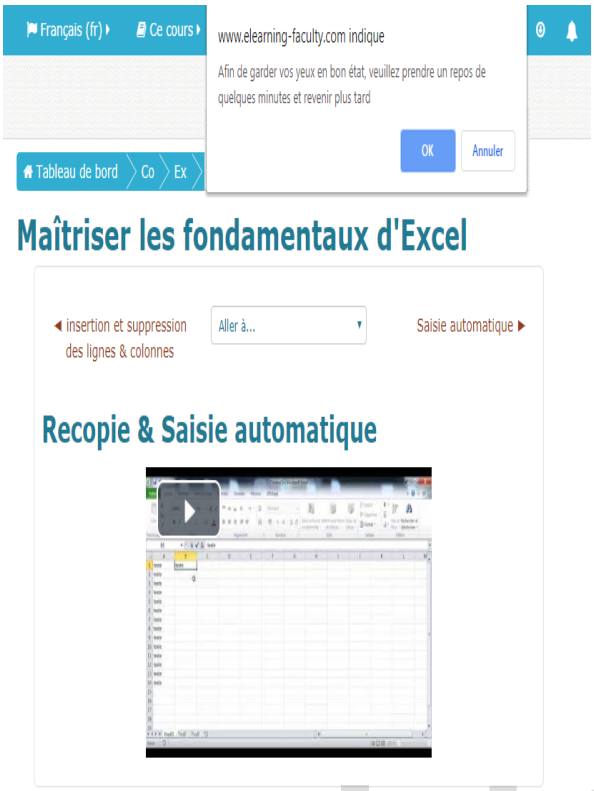

FIGURE 8 : THE DEMANDE OF BREAK MESSAGE

After integrating the agent to the platform, we had tested the reaction of learners on Excel training we remark that the number of learners satisfied with this integration is 89%.

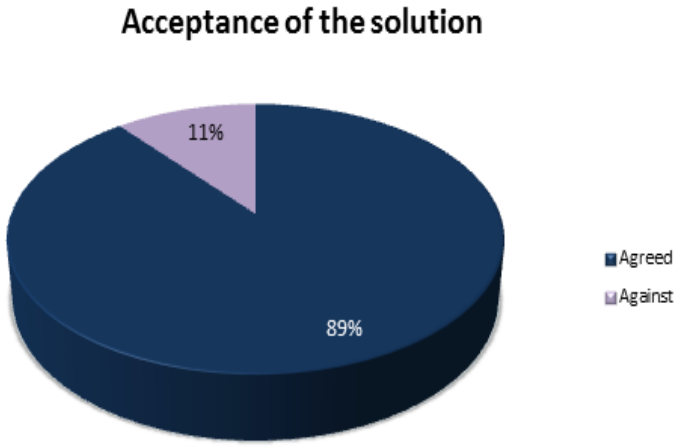

FIGURE 9 : ACCEPTANCE OF THE SOLUTION

The number of learners who had accepted the idea of the solution in the survey was 69.9% and after the integration of the solution the number of satisfied learners is 89%. As can be seen, the integration of the solution on the e-learning platform has shown its advantages.

However, learners take different intervals to continue the course each one to his preferences, as shown on the table below:

TABLE 2: STUDENTS' INTERVALS OF CONTINUING COURSES

Intervals to continue the course	Number
After few minutes	20
After few hours	24
Next day	17
After 2 days	5
Next week	3
Never	4

We were able to verify the robustness of our solution given the high degree of satisfaction of the learners.

CONCLUSION AND PERSPECTIVES

In recent years, eye diseases have spread a lot among computer users, for what we came up with the idea of designing a multi-agent system for the detection of the advisable time for a learner in an e-learning platform.

In order to validate our proposal, we integrated it with the e-learning platform of the Faculty of Arts and Humanities at Moulay Ismail University. We made experience with learners of License and Master. The advantages of this time learning detection system are 1. This concept represents an innovative idea to protect learners' health, and 2. The model has shown its utility based on learners feedback and results.

This project gives a good number of satisfied learners. As can be seen, the integration of the solution on the e-learning platform has shown its advantages.

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