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Design of intelligent agent on Moodle to automate the learning assessment process

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ABSTRACT

Assessment is a key element in today's School system, whether face-to-face or distance learning, as it helps students understand their learning and get feedback on their progress. In addition, distance learning assessment is becoming increasingly popular as it is convenient for students with busy schedules who cannot attend face-to-face assessments. In this paper, we focus on the use of intelligent agents on the Moodle platform to improve the assessment process of distance learning. We present three contributions that aim to improve the developed models: firstly, the digitisation of assessment to collect, store and analyse data; secondly, the adoption of a multi-agent skills assessment environment to automate some assessment tasks; thirdly, the adoption of the leadership and management development (LMD) programme to improve the continuous training of learners by offering greater flexibility, adaptability and relevance to their needs.

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1. INTRODUCTION

In the current education system, distance learning as defined in [1] refers to all types of training that take place without the physical presence of learners during lessons. Similarly, teachers are not necessarily present in their establishment when they prepare or deliver their lessons. Historically, distance learning began with correspondence courses, where learners and teachers communicated by mail. In the 1990s, courses began to be delivered over the internet, providing new opportunities for teachers and students. Today, any device can be used to support lessons, revolutionizing the way learning happens. There are many ways to learn (or teach) remotely, and some are already well established in the education landscape and include (video conferencing, and synchronous learning).

Assessment is an essential component of the curriculum. It helps students understand their learning and provides feedback on their progress. Whether conducted face-to-face or remotely, the purpose of the assessment is to inform students about their learning. Additionally, the distance learning assessment [2] is becoming increasingly popular as it is convenient for students who have busy schedules and cannot attend face-to-face assessments. It is also practiced during the COVID-19 health crisis [3]. Distance learning assessment is a process of collecting information about the learner's level of learning before, during, and after online training. The trainer must then interpret these results to draw up an assessment of the learner's level and measure the

effects of the training. This data collection is done remotely via web and information and communication technologies (ICT) tools [4]. Thus, more and more software in "as a service" (SaaS) mode integrates this type of functionality and allows the creation and analysis of remote assessments.

Most distance learning in a university context involves a virtual component that allows activities to be carried out in synchronous or asynchronous mode, thanks to technology. Thanks to the internet, the isochronous and simultaneous physical presence of the teacher and the students in the same place is replaced by videoconference meetings, the downloading of documents previously downloaded on a digital learning environment (DLE), offline interaction tools such as forums or wikis, and any other digital tool whose purpose is to help learning. In distance education, the most complex task is that of evaluation, given its many objectives such as experience feedback, grading and motivation as mentioned by Grivokostopoulou *et al.* in [5], improve student learning, follow learners more individually, identify their strengths and weaknesses, communicate with stakeholders. Or even individualize learning paths according to Zabolotskikh *et al.* in [6]. On the other hand, thanks to academic dishonesty as defined by Elsalem *et al.* in [7], especially real-time cheating, often in online exams.

The work of Ringuet *et al.* [8] concerns the development of a model for the evaluation of distance learning. This model is divided into three levels: the first level includes the classic stages of an evaluation, such as setting objectives, measuring performance, judgment and decision-making. The objectives must be clearly defined in order to be able to measure the performance of the learners. Performance measures must be valid and reliable, and judgments must be fair and unbiased. Second level involves collaboration between different actors for a more comprehensive assessment [9]. This includes learners, teachers, tutors, content experts and external assessors. The collaboration between these different actors makes it possible to obtain a more complete assessment and to take into account the different points of view. Third level concerns the overall evaluation process and includes stages such as techno-pedagogical analysis, techno-pedagogical planning, prototyping, design and production [10]. These steps are designed to improve the efficiency and accuracy of distance learning assessment by integrating collaboration between different actors and the use of digital technologies.

The distance learning evaluation models already developed have several levels, which implies close collaboration between different actors for a more complete and precise evaluation. However, this complexity raised by Wang *et al.* in [11] can make it difficult to implement in practical settings. Indeed, collaboration [12] between the different actors requires significant resources in terms of time, personnel and technology, which can be difficult to obtain in already distance learning environments forced. In addition, the overall evaluation process, which includes techno-pedagogical analysis, techno-pedagogical planning, prototyping, design and production, can be long and tedious to put in place, especially for teachers and educational teams with high workloads. Therefore, the implementation of this model may require adjustments to accommodate the specific resources and constraints of distance learning environments. To this end, we have therefore dedicated this work to improve the performance of the evaluation of distance learning, through three contributions that aim to improve the models developed. The first contribution is to digitize student assessment by using digital tools to collect, store and analyze assessment data. The second contribution aims to change the actors and collaborators involved in the assessment by adopting a multi-agent skills assessment environment [13]. This involves the automation of certain evaluation tasks through software agents capable of collaborating with each other and making decisions in real time. The third contribution consists in developing continuing education by adopting the leadership and management development (LMD) program, which has several advantages in terms of flexibility, adaptability and relevance to the needs of learners.

The rest of our document is organized as follows: in section 2, we present related work on remote evaluation, while recalling the work of Ringuet *et al.* [8] that inspired us, as well as the innovative approaches used. Section 3 describes in detail the new multi-agent system modeling the skills assessment environment as well as the methods proposed to improve the performance of the assessment process. In section 4, we present the results and the discussion of the work. Finally, in section 5, we conclude by summarizing the results obtained and by evoking the future prospects of our research.

2. RELATED WORKS

2.1. Remote skills assessment

The remote skills assessment process [14] is an assessment method that assesses the skills of learners through online learning activities and digital tools [15]. This assessment method is increasingly used in e-learning programs to assess learner skills, especially in the context of e-learning. The remote skills assessment

process is based on a series of key steps, which include defining the learning objectives and skills to be assessed, designing the assessment activities, implementing the assessment and analysis of the results of the evaluation. Remote skills assessment can be carried out using a variety of digital tools such as online quizzes, collaborative projects, discussion forums, e-portfolios, simulations, and serious games. These tools allow learners to interact with course content, work together to achieve common learning goals, and demonstrate their understanding of key skills. The remote skills assessment process can be used in different educational settings, including online training programs, blended learning programs, and distance learning programs.

Several approaches in the field of distance skills assessment. One of them is the use of artificial intelligence (AI) [16] which allows the analysis of evaluation data in real time, the personalization of the evaluation according to the learner needs and skills and decision-making. Virtual and augmented reality [17] is also increasingly being used to simulate immersive and realistic learning and assessment environments, providing a more interactive learning experience for learners. Gamification as presented by Saleem *et al.* in [18] is another approach that uses game mechanics to stimulate learner motivation and engagement in assessment systems. Peer assessment is also increasingly being used to reduce teacher workload and provide a more collaborative learning experience for learners. Finally, the use of video [19] is increasingly common for the assessment of practical skills in artistic and creative fields.

2.2. Cardinet evaluation process

Leroux *et al.* in [20] presented a global model of the skills assessment process, focused on student success in distance education (DE). This model consists of collecting information on the learning achieved by the student, and interpreting it to make judgments and the best possible decisions on the quality of teaching and the level of student learning, and it uses the commen integration shown by Margot and Kettler [21] and Web 2.0 in [22] tools and which can be repaired by the teaching and learning context, online and formal and informal activities proposed in [2]. This so-called classic evaluation process, which is similar to a research process, takes place in four stages: target, measurement, judgment and decision. The cardinet evaluation process is a cyclical process divided into four stages, target, measurement, judgment and decision as shown in Figure 1. The target is used to define the content, plan the assessment, and determine the assessment schedule and tools. The measurement consists of evaluating knowledge and skills using appropriate and diversified means. The judgment is the correction and the interpretation whether formative or certifying, finally, the decision is to give an opinion on the achievement of the learning objective.

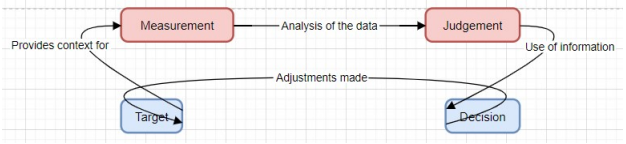


Figure 1. Cardinet evaluation process

The different stages of the remote evaluation process require a list of tools and methods that can be used for each role involved in the process, namely the designer, the producer, the teacher, the student and the other actors at the serving students and teachers. The first stage, target, consists of clarifying training objectives and determining formative and summative assessment activities, which can be carried out using different ICT and Web 2.0 tools such as forums, blogs, videos and Moodle. The second stage, measurement, involves the development of tasks and rubrics, which can be completed using various tools such as group projects, quizzes, exams and digital portfolios. The third stage, judging, involves students completing assessments, which can be done using the same tools as stage two. Finally, the last step, decision, involves making the students learning decide, using tools such as Moodle [23] and PDF or Word documents. Based on the LMD system, it recognizes three national diplomas and grades (bachelor, master and doctorate). In this system, the student will benefit from educational support throughout his course to help him define his training objectives and implement them. Thus, the student will be able to build his training program and his professional project on the basis of a standard program. They will be able to modify it or make it evolve by choosing options. There will be bridges between the different courses, that is to say that the student will be able to modify his choices or reorient himself from one field to another while maintaining the knowledge acquired in the previous courses.

3. METHOD

3.1. Multi-agent systems engineering method

The bachelor-MASSA system is an intelligent skills assessment environment available to undergraduate students during bachelor cycle assessments. For the modeling of our system, we use the MasE methodology introduced by González-Briones *et al.* applied in [24]. Which consists of seven steps grouped into two main parts as shown in Figure 2, the analysis and design phases. The purpose of the first phase is the production of the roles that the system must fulfill in its objectives. The design part aims to give the concrete realization of the multi-agent system by assigning goals to specific classes of agents; this amounts to constructing the conversations between the agents by defining the internal architecture of the agents where the reasoning processes are integrated.

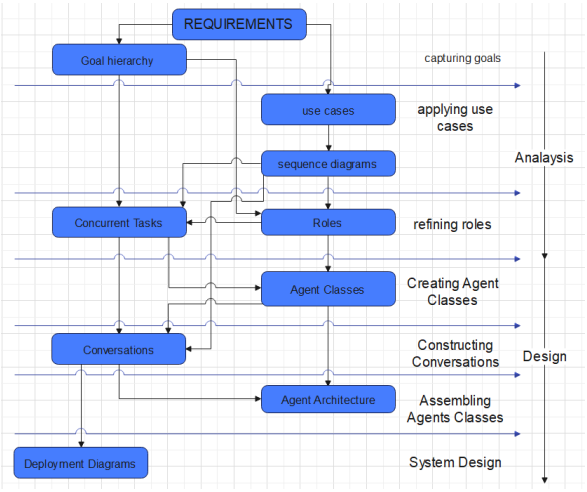
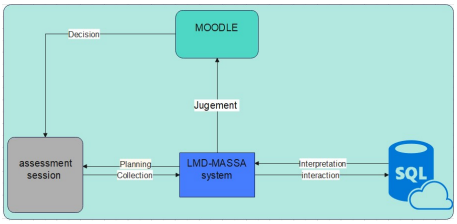


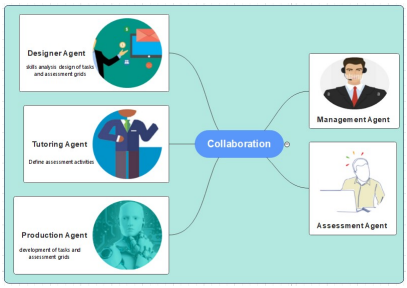
Figure 2. Multi-agent systems engineering method

3.2. Skills assessment environment

The first has just brought the cardinet assessment process to the LMD system, i.e. involving the use of digital tools and resources across the stages (target, measure, judge and decide) to assess our students' work (exams and presentations). We present in Figure 3 an overview of our LMD reform remote assessment system, as shown in Figures 3(a) and 3(b) we have distinguished five types of agent: the designing agent, the teaching agent, the producing agent, the managing agent and the devaluing agent.



(a)



(b)

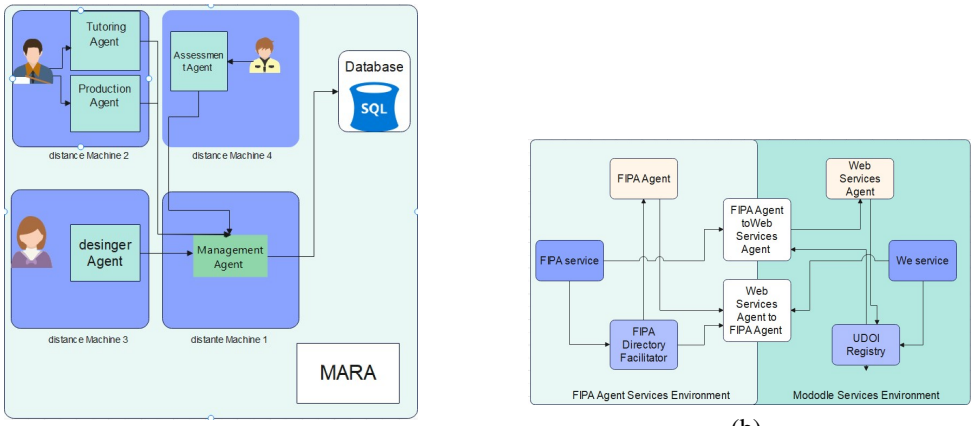
Figure 3. Overview of LMD reform remote assessment system (a) competency assessment environment and (b) LMD-MASSA system

3.3. The implementation of a multi-agent skills assessment environment in the JADE platform

Figure 4 provides an overview of the multi-agent remote assessment (MARA) and WS2JADE integration architecture. It illustrates the main concepts and components of the MARA system and its integration with

the Moodle platform. The figure also shows the types of agents involved and the interactions between them. In Figure 4(a), we present an overview of the MARA, with the types of agents present in the system. In MARA, the learner needs a web browser to access the Moodle platform and take the assessment. Each user has a Java agent development framework (JADE) [25], each agent is a class that inherits from the agent parent class and redefines the functions that describe the agent's life cycle in the platform.

JADE's remote monitoring agent (RMA) allows you to manage the life cycle of the platform and all the agents that make it up. For each group (container), we have developed agents that we call parents (mother class) and the agents that will be created from the RMA will inherit these parent agents. The exchange between agents within MARA is done through roles. The JADE platform offers a tool called agent sniffer which allows you to trace exchanges between agents. The tasks that an agent must perform are called behaviors in JADE. JADE's agent dummy tool allows the user to interact with their resources in a special way. The interface allows the creation and transmission of agent communication channel (ACL) and keeps track of all ACL messages sent and acquired. This list can be consulted in detail or even modified. We were able to detail our MARA platform, however the integration side with the Moodle platform remains less explicit. For this reason, we used the WS2JADE technology [26] which aims at a symmetric integration of FIPA-compliant agents and web services as detailed in [27]. The latter, which uses a strategy based on proxies, allows the two platforms to develop independently of each other. This policy recognizes parity between agent roles and web services provided by Moodle. As shown in Figure 4(b), it is believed that there is a parallel agent service environment and a web service environment. By converting ACL messages into web service invocations, found at the line separating the two environments, allows agents to access web-services.



(a) (b)

Figure 4. Multi-agent remoteassessment: (a) overview of MARA anf (b) WS2JADE integration architecture

3.4. Implementation of a remote skills assessment in an LMD education system

After The implementation of a multi-agent skills assessment environment in the JADE platform. At the third level of the process, we have replaced continuing education with the LMD reform. For the implementation of a distance skills assessment in an LMD education system, we will follow the steps applied by Guerrero-Roldán and Noguera in [28] but this time for this LMD reform, first the technical-pedagogical analysis to determine and analyze the target of the training, secondly the technical-pedagogical planning and the realization of the specifications of the learning and evaluation activities. Third, the prototyping phase that brings a sample of these activities to life. Fourth, the design and implementation of all evaluation activities (quizzes, exams, evaluation grids, written production, oral presentation, and case studies). Finally, it is the production, that is to say the mediatization, which recalls all the technological tools that will make it possible to improve the evaluation process, such as (digital portfolio, Screencast-0 -Matic, mobile apps, and MP3 file).

4. RESULTS AND DISCUSSION

To verify the proper functioning of our platform, and after a technical upgrade consisting of introducing learners to basic computing and the use of the various tools of the Moodle platform as in [29]. We moved

on to the educational use phase by creating a virtual class of 130 first-year students in higher education of the LMD reform, after having broadcast four capsules, of course, each capsule is dedicated to a specific axis. Then we moved on to formulating and correcting the tutorials. After numerous discussion forums, review activities and self-assessment tests, we supervised the examination of the "computer science 2" module in the Moodle platform coupled with our multi-agent remote assessment model, in which all the statistics are grouped together in Tables 1 and 2.

Table 1. Information on the modules examined

Test	T-n of attempts evaluated	Max-score	Min-score	The high-score	Low-rating
Computer Science II	130	10	-10	10	-2.5

Table 2. Characteristics of the module examined

Average score	The median score	The standard deviation	The asymmetry	Flattened the grade distribution	Internal consistency coefficient	Ratio error	Standard error
4.92	5.25	2.57	-0.67	0.09	0.56	66.04	1.70

To measure the performance of our MARA platform, several metrics can be used. First, the student retention rate can be measured to assess the percentage of students who remained enrolled throughout the instructional period. A high retention rate indicates that students are satisfied with the platform and find value in it. Next, the course completion rate can be used to measure the percentage of students who completed the courses offered on the MARA platform. A high completion rate indicates that students are engaged in learning and have found the courses interesting and useful. Average time spent on the platform is also an important metric to consider, as this measures the average amount of time students use the platform. A high average time indicates that students find the platform useful and that they spend a lot of time on it. Student satisfaction can also be measured by using surveys or interviews to collect this data. Success rate is another metric that can be used to measure the performance of the platform. This measures the percentage of students who passed exams and assessments on the MARA platform. A high pass rate indicates that students understood the course content and learned well. Finally, the student engagement rate measures the degree to which students are engaged in platform activities, such as online discussions and forums. A high engagement rate indicates that students are active and involved in learning. Table 3 presents the performance measurement statistics of the MARA platform.

Table 3. Performance metrics for MARA platform

Performance metric	Result	Target
Course completion rate	80%	85%
Average time spent on platform	2 hours/week	3 hours/week
Average number of activities per Student	10 activities/module	12 activities/module
Student satisfaction rate	75%	90%
Exam pass rate	70%	80%

Table 3 presents the performance indicators for the MARA platform, including the results achieved and the corresponding targets for each indicator. The indicators include course completion rate, average time spent on the platform, average number of activities per student, student satisfaction rate, and exam pass rate. The table shows that while the platform has performed well on most of the indicators, there is still room for improvement in order to meet the set targets. To obtain feedback from students on the use of the MARA platform, particularly with regard to its ergonomics, design and ease of use, we opted for direct interviews with them. We have chosen this method of data collection because it emphasizes open-ended responses, which provide more precise and richer information than responses to questionnaires. Moreover, this approach was easily feasible due to the limited number of interviewees. The direct interviews conducted with the students made it possible to assess their level of satisfaction with the use of the MARA platform. The results showed that the majority of students were satisfied with the ergonomics and ease of use of the platform. They also appreciated the sleek design of the platform, which promotes intuitive and pleasant use. However, some students expressed difficulties in using certain features of the platform, such as navigating between the different modules. However, overall positive feedback from students highlighted the effectiveness of the MARA platform as a distance learning tool.

5. CONCLUSION

In conclusion, our study highlights that the digitalisation of distance skills assessment in higher education is evolving and offers many opportunities to improve the quality of distance learning. The results of our research have shown that the implementation of a multi-agent system for distance assessment can have a positive impact on the effectiveness and relevance of assessment. In addition, the adoption of the LMD programme for continuing education offers greater flexibility and relevance to meet learners' needs. However, it is important to stress that e-learning will never completely replace the teacher, but should be seen as a complement to face-to-face teaching. Finally, we encourage higher education institutions to continue to explore the opportunities offered by the digitalisation of higher education in order to provide students with quality, relevant and socially relevant education. Although our work has focused on improving the assessment of distance learning, it is important to stress that this should not be seen as a single solution to all the problems encountered. The use of technology should be seen as a means of supporting and enhancing traditional teaching and learning methods, rather than replacing them. It is therefore crucial to continue to explore new ways of integrating technology into higher education in a way that is effective and relevant to the needs of learners and teachers.

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