Teaching "Information Systems Management" with Moodle

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Abstract—This paper describes an overview of the "information systems management" course implemented in Moodle platform. The course is prepared for FPJ faculty students while respecting the competency learning principle. To design the learner path, this work used the fuzzy c-means clustering (FCM) for finding the learners profiles. The goal is to construct a personal course depending on the competency for each student in the same platform. The students response to this work has been very positive, which encourages to generalize this work for other courses..

Keywords—Moodle, E-learning, Fuzzy c-means, Competency learning

1 Introduction

In classical teaching the course is conducted with the same rhythm for all students. However in any classroom, the level is very heterogeneous, if the teacher raises the level of his training, only the best students can benefit from the information of the course [20]. By cons, if he tries to lower the level, all the categories of students will follow the course, but brilliant students will be bored. In order to find a solution to this problem, many approaches can be used [18].] The most used of which is the competency learning [19].]. This approach is seen as the construction of the course which focused on progression in learning for a student. It is less stigmatizing for the student, and it allows the learner to develop his/her own potential [9].The competence approach also meets a need to make more practical training, in particular for a more effective employability [5], while , the knowledge approach would raise too little motivation from students. The competency-based approach is focused on students learning making them more autonomous. The competency-based approach will re-

spond to a collective need, where social issues are increasingly complex and require a high level of interpersonal and cognitive competency. In return, we must not underestimate certain limitations related to the difficulties of the implementation of a program referring to the competency approach [1], as the program requires a reviewing of the teachers methodology. The teachers must prepare a dynamic course for addressing the competence of each student for a limited time in a static environment [2]. The environment that we can offer this dynamism is the virtual learning platform [17]. E-learning offers a wide range of tools which allow students to trace their own learning path. This kind of learning has also two advantages: on the one hand, it manages a personal course (lesson, assignment, quiz, etc.). On the other hand they enable to ensure a collaborative learning either synchronous (video conference, chat, forum, etc.) [13]. These benefits and others, explain that E-learning systems have grown exponentially in recent years, due to the fact that they accumulate a large amount of information, analyze the students behavior and assist the teacher in the detection of possible errors or shortcomings [16]. The strategy adopted in this work to improve the e-learning process is to adapt the Moodle platform based on the learner profile. This work utilized fuzzy c-means to classify the students into clusters based on the profile of learners [10]. The rest of this paper is organized as follows: Section 2 describes the Moodle platform [8].Section 3 introduces the theoretical review for the fuzzy clustering techniques used. Section 4 describes the materials and methods of the work presented in this paper. Section 5 presents the experiments design and results analysis. Finally, the conclusions and further research are outlined in Section 6.

2   Moodle Platform

Moodle (modular object-oriented dynamic learning environment) [7] is an on-line learning platform. It is renowned for its ease of use, intuitive side, active community that supports it and the large number of features offered [6]. Moodle is adopted by a growing number of institutions, schools, universities, but also by companies wishing to offer a distance learning method to their employees and customers [11]. Moodle offers several resources (chat, lesson, quiz, etc.), in addition to complementary modules that extend its functionalities. Thebasic Moodle allows an educational material on a space that can be used either freely or with a password [15].

Moodle provides educational or communicative functions to create an on-line learning environment: it is an application or creating the interactive courses, through the network of interactions between educators, learners and learning resources [12]. Several activities and resources are present in Moodle:

— Chat: or chat room (possibility of opening a certain day, at a specified time, weekly, etc.);
— Forum: different types of forums (topics imposed by the teacher, topics proposed by students, evaluation or possible comments, etc.);
— Assignment: homework with teacher evaluation (different types: text online, file repository, advanced file repository, off-line activity);
— Quiz: following multiple choice, true / false, numeric questions ;

— Lesson: document containing questions and referrals to different learning paths depending on the answers (possible evaluation);
— Workshop: refurbishment work with student evaluation;
— Glossary: collective production of a document organized alphabetically (comment, possible validation and evaluation);
— Wiki: collective production of a hypertext document (possible comments of the teacher);
— Database: creating records with custom fields and search by criteria in the database;
— Groups: members of a course can be separated into groups (and have access to restricted parts of the forum, for example) or group of groups (which completely restrict access to resources / activities).
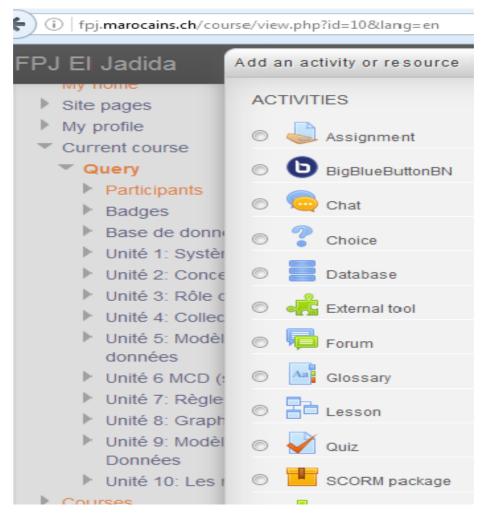

Fig. 1. Moodle Activities and Resources

By using Moodle, the students have the privilege of access to a range of educational materials, interact with teachers and comrades. Likewise, the teachers can manage, promote learning and make an efficient interactive course [14]. Moodle presents multiple advantages, therefore, it has become a staple platform [8].

3 Fuzzy C-Means (FCM)

Many clustering methods are introduced in the literature. We can find two methods: hard and fuzzy. In hard clustering algorithms, the object belongs to one class. In fuzzy clustering algorithms [4], objects can belong to all classes with different degrees of membership. This is appropriate for real-world data where boundaries between clusters are not well-defined. Therefore, fuzzy clustering presents the advantage of dealing with overlapping clusters [3].

3.1 Fuzzy c-means algorithm

Let $X=\{x_1, x_2, x_3,..., x_n\} \subset \Re^p$ a set of n objects with the dimension p. Partitioning X in c clusters can be defined by a matrix $U =[u_{i,j}] \in \Re^{nxc}$ which satisfies the three conditions:

$$0 \le u_{i,j} \le 1; \quad 1 \le i \le n; \quad 1 \le j \le c \tag{1}$$

$$\sum_{j=1}^{c} u_{ij} = 1; \quad \forall 1 \le i \le n \tag{2}$$

$$0 < \sum_{i=1}^{n} u_{ij} < n; \quad \forall 1 \le j \le c \tag{3}$$

with u_{ij} is the membership degree of x_i for the jth cluster.
FCM algorithm optimizes the J_m criterion defined by

$$J_m(U,V) = \sum_{i=1}^{n} \sum_{j=1}^{c} (u_{ij})^m \|x_i - v_j\|^2 \tag{4}$$

where

— $V(v_1, v_2,...., v_c) \in \Re^{cxp}$ and v_j is the jth prototype
— m ($1 < m < \infty$) is a parameter used to control the level of fuzziness in the resulting clusters
— $\| \; \|$ is a norm to measure the distance between the jth prototype and the ith data point.

Bezdek showed that FCM always converges to a minimum of J_m under two conditions:

$$u_{ik} = \left[\sum_{j=1}^{c} \left(\frac{d(x_k, v_i)}{d(x_k, v_j)} \right)^{2/m-1} \right]^{-1} ; \ 1 \le i \le c; 1 \le k \le n$$

(5)

$$v_i = \frac{\sum_{k=1}^{n} (u_{ik})^m x_k}{\sum_{k=1}^{n} (u_{ik})^m} ; \ 1 \le i \le c$$

(6)

The FCM algorithm is given in Algorithm 1.

Data: Vector of objects X: $(x_1, x_2, ...x_n)$
Result: Prototypes $(v_1^*, v_2^*, ..., v_c^*)$
Choose:
- $1 < c < n$
- $m > 1$
- t_{max} maximum number of iterations
- ϵ tolerance threshold
- norm for clustering criterion J_m
- norm for calculating errors $E_t = \|V_t - V_{t-1}\|$
Initialization:
- prototypes V_0
- $t \leftarrow 0$
while $(E_t > \epsilon$ *and* $t < t_{max})$ **do**
$\quad$ $t \leftarrow t + 1$
$\quad$ Calculate U_t by using Eq. (5)
$\quad$ Calculate V_t by using Eq. (6)
Use $U^* = U_t$ and/or $V^* = V_t$

Algorithm 1. Fuzzy c-means Pseudo-code

3.2 Exploitation of the results produced by FCM

The two matrix (U^*, V^*) generated by FCM as outputs can be exploited in different ways and for different purposes. for example, to evaluate and compare the quality of

the corresponding partitions in the data set X, one or more validity indices dependent on U and / or V can be evaluated for Each clusters [3]. Another Important task is to exploit U* and U* for labeling the element forming X. This operation is equivalent to the formation of a hard partition in term for assigning each object to the class for which it has the highest degree of membership. The method adopted in this study is to apply for the N students X($x_1, x_2, ..., x_N$) the rule of the nearest prototype (1-PPP) using V*. This rule assigns each object vector x_k to the class i whose the prototype v_1^* is the closest by respecting the equation 7

$$i = \arg\min_{j \neq k}\left\{\left\|x_k - v_j^*\right\|\right\}$$

(7)

4 Materials and methods

In edit Mode, Moodle offers several options for managing a course: the number of sections, the course format, guest access, the group mode and the role renaming (Figure 2).

In our course, 10 sections are chosen, each one corresponds to a specific area of "Information Systems Management" module respecting the official syllabus. Each course section provides a set of activities:

— Lessons give detail on the knowledge that a student should know, these lessons are organized saw tooth; each web page has a notion to be assimilated by students and followed by a quiz. Depending on the student's response the system directs the student to the appropriate web page. The system stimulates the student to review the basic course if he/she has got a very bad grade, or to pay more attention to certain details of the course (Algorithm 2) ;
— Video sequence that explains the exercises;
— Video conference allows different students to communicate with teacher and stimulates a real classroom;
— Chat allows students to ask questions and wait for a response either from their colleagues or teacher;
— Forum represents an area where students can express their opinions or simply answer the question;
— Quiz is a way to test the level of students and assess their knowledge and experience;
— Database allows to build, display and search records in a bank on several subjects;
— Assignment offers a set of exercises that students can't respond either by a group or alone and send their answers to the teacher;
— Wiki enables students to add and edit a collection of web pages in the treated section. It allows them to enhance their knowledge.
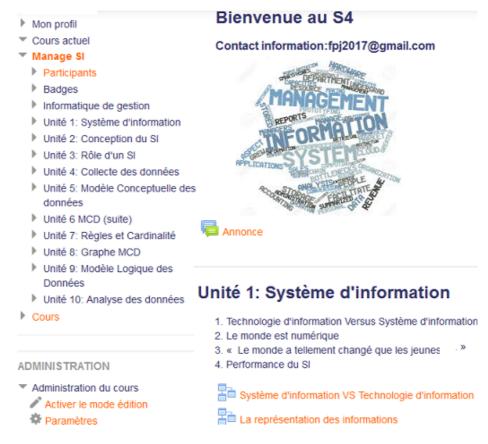
Fig. 2. Information systems management course

The section planning is updated each week (figure 3). The platform provides students a Java applet that allows them to draw graphs for the model Merise. The course grade management depends on the different tasks performed by students. Each task has a coefficient (weight). In this work the weight 10 % is allocated to the forums, the we have established in the, for the quiz a weight 15 % to the quiz, 40 % to assignment (homework) and 35% to the project. Based on the course grade, the work used fuzzy c-means for clustering the student data sets into five clusters: absent students, absent student with reason (causal students), bad students, regular students and excellent students. The overlapping can be perceived in the context that a student can have a good result in one section and bad in another.

Classification of students ;
absent student $\leftarrow$ 1; $(Mark \leq 1)$;
causal student $\leftarrow$ 2; $(1 < Mark \leq 2)$;
bad student $\leftarrow$ 3; $(2 < Mark \leq 8)$;
regular student $\leftarrow$ 4; $(8 < Mark \leq 14)$;
worker student $\leftarrow$ 5; $(Mark > 14)$;
Use FCM for the n students X $(x_1, x_2, \ldots . x_n)$;
$i \leftarrow 1$
while *(not end of course)* **do**
    Learn $Section_i$
    Evaluate $Quiz_i$
    $Marks_i \leftarrow EvaluateQuiz_i$
    switch $Marks_i$ **do**
        case *1*
         | Go $Section_1$
        endsw
        ;
        case *2*
         | Go $Section_{i-1}$
        endsw
        ;
        case *3*
         | Go $Webpage_1$
        endsw
        ;
        case *4*
         | Go $Webpage_{i-1}$
        endsw
        ;
        case *5*
         | Go $Webpage_{i+1}$
        endsw
        ;
    endsw
    $i \leftarrow i + 1$
end

Algorithm 2. Student learning path

Unité 6 MCD (suite)

1. Règle de gestion
2. Dépendance fonctionnelle
3. Construction d'un graphe MCD

Construction d'un MCD

Question sur le graphe MCD

Cardinalité par l'exemple

Travail à faire

Rappel sur le graphe MCD

Exercice sur Le MCD

Contrôle Graphe MCD

Question réponse pour BF

Unité 7: Règles et Cardinalité

1. Importance des règles de gestion
2. Cardinalité
3. Exemples du MCD

Cardinalité

Exemple, Cardinalité

Travail à faire

Exercice didactique

Fig. 3. Activities for one section

5   Experiments and results analysis

This section presents some results concerning the students' performance during the use of our Moodle platform. Three experiments are established to test the effectiveness of our platform. With a number of 215 students for two academic semesters, we have compared three methods:

− A classic course in an amphitheater without use of information technology(Classic);
− A course with Moodle platform, but in this case the technique is based on downloading courses by students without interaction between the various stakeholders in the educational process. Unfortunately this strategy is often adopted by many universities (Semi classic);
− An interactive method which allows educational monitoring and classifies students by their performance (FPJ Work).

5.1   100% E-Learning

In this first experiment, our work consists in an online course without making meetings in the amphitheater. The educational monitoring is performed in the platform, the direct social communication is missing. The experiment was conducted during two semesters with a total of 215 students. Table 1 summarizes the results: it is very clear that according to the results, the technique of using an on-line learning by providing an electronic document without monitoring is a bad approach (Semi Classic). In fact, the number of "bad students" is very large; it is equal to 0.55 even for the "absent students".

Table 1.   100% E-Learning results for different classes

Class	Classic	Semi Classic	FPJ Work
Absent	0.4	0.5	0.3
Causal	0.3	0.4	0.15
Bad	0.4	0.55	0.35
Regular	0.45	0.35	0.35
Excellent	0.15	0.1	0.3

5.2   E-Learning with social monitoring

In the second experiment, our work consists in an e-learning with making meetings in the amphitheater. The educational monitoring is performed in the platform, the direct social communication is established for all the students. The experiment was conducted during two semesters with a total of 215 students. The table 2 summarized the results: The same considerations remain valid for this second experiment, however, a change is effected for our work at the "regular students" who increased with the value 0.05

Table 2. Social monitoring results for different classes

Class	Classic	Semi Classic	FPJ Work
Absent	0.4	0.5	0.3
Causal	0.3	0.4	0.15
Bad	0.4	0.55	0.25
Regular	0.45	0.35	0.25
Excellent	0.15	0.1	0.3

5.3 E-Learning with group monitoring

In this experiment the principle of our platform remains unchanged. The E-Learning with meetings in the amphitheater is established and the educational monitoring is maintained in the platform. But we classify students by learning performance into four groups. Note also that the groups are selected in a random manner. The results are referred to table 3. Our technique surpasses all other methods, we have a very positive change in the number of "Excellent Students" , a remarkable increase is observed. Regarding technical and socio-psychological factors involved in this experience, it is easy to say that an "effect of group" influences the results. The students are perhaps more inclined to work harder when they know that their teachers are available at any time to support them in E-learning platform, encourage them in small groups and discuss with them face-to-face. Consequently the students' scores raise high.

Table 3. Group monitoring results for different classes

Class	Classic	Semi Classic	FPJ Work
Absent	0.4	0.5	0.3
Causal	0.3	0.4	0.15
Bad	0.3	0.4	0.1
Regular	0.4	0.35	0.5
Excellent	0.3	0.25	0.4

6 Conclusion

Moodle is a promising way for teachers to organize, and to manage an electronic educational sequence. In addition, the multimedia tools offered by Moodle allow to create interactive and attractive activities making the learning process easier for students. Therefore, these activities increase the interest of the students and motivate them to accept the learning process. Unlike the classic classroom, in Moodle platform teachers can diversify the activities and resources. By chat, video conference, Moodle makes easier the interaction with the students in real-time and also allows to know their opinions, difficulties, knowledge and suggestions. Teachers can intervene at any time to solve the problems of their students or impel them to find a solution together.

In this work we focused on the benefits of adopting the platform Moodle in faculty learning process. We also reported that a follow-educational "face-to-face" with a student group was proved to be beneficial to student learning. In this work we also used a relevant Fuzzy c-means algorithm to extract the student profile for promoting his/her learning which respects his/her competencies. However, the preparation of an interactive course with Moodle tools takes time and effort. That is why we plan to create an IT researchers association to exchange experiences and prepare together courses through the Moodle platform.

7　Acknowledgment

8　References

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