Intelligent System Design Requirements for Personalizing e-Learning Systems: Applications of AI to Education*

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Personalized learning aims at recognizing learner's cognitive skills and learning preferences in the learning environment. Personalized learning offers flexibility in learning as blended learning. Modeling personalized learning involves identifying learners' styles and offering the learning options in any learning environment and associated learning management system (LMS) in use. In this context, learning management system design involves considering heterogeneous learners' capabilities and styles. In traditional classroom format, a teacher modifies content-related activities based on the various levels of learners' capabilities and learning preferences. However, due to the lack of adaptive interaction tools in the current LMSs, LMSs do not learn the users' learning styles whilst the teacher does. The work presented in this paper includes a study of producing design requirements for an intelligent learning shell to be implemented, with the learning technology in use, which adapts learners' learning styles. The study aims at recording the effective multi communications that are related to the curricular activities. Among these activities are: obtaining e-object, assessment, assignments, group projects. These activities were performed using modern approaches like peer-to-peer learning, cooperative work and filling in the knowledge gaps. The study introduces recommendations related to both learning styles that help in personalizing the LMS associated and the tools that employ these modern approaches. In this paper also there is a quantitative study outcome.

Keywords: blended learning; interaction with e-learning systems; adaptive LMS

1. Introduction

1.1 Foundation of personalized learning

Personalized Learning terms have been defined in last decade as Independent Learning (IL). IL indicates non-classroom learning environments as IL was first defined by parents as out of school learning. This includes: technology-based learning and/or community-based learning. Independent learning in context of technology based learning is the personalized learning of interest in our research. Hence, considering technology-based learning, Microsoft declared that by studied the intensive use of technology in education, learners use computers on a daily basis for schoolwork at home more than at school [1]. In addition, the use of technology out of classroom hours has been shown to provide meaningful learning experiences for all learners especially those who cannot properly interact within the classroom, [2]. Several interactive e-learning technologies have evolved in the last two decades aimed at utilizing information and communication technology tools to improve learning outcomes. These improvements were measured during different interaction styles due to the heterogeneous learners' capabilities [3]. Therefore, teachers using LMS should assure that the services provided by the LMS in use satisfy the learners' learning styles and the nature of the course they undertake; [4], to benefit from using technology.

Personalized Learning implies personalising the presentations of learning e-contents; commonly known as learning objects (LOs) that matches the user's preferences and needs. In addition, personalized learning provides the user tools to reconfiguration the learning environment in some learning management systems (LMSs). For instance, the LMS provides personalised learning paths for learners based on personal data. The emphasis of individual personalization using the LMS is to keep records of information on the learners' behavior [5]. The recorded information of learners behaviour includes, for example, which documents they visit, how long they spend viewing them, test results and grades.

Recalling that the recorded information is monitoring learners' behavior from the teachers' perspectives. Monitoring learners' behaviour is considered kind of tutoring in the educational process. Accordingly, the LMS in use should possess monitoring tools to help in closely tutoring the learners. The next section provides some of the key aspects in an interested comparison between human tutoring and intelligent tutoring systems.

From the learners' perspectives, personalized learning functions should prevent long searching, missing some steps regarding time frame for submissions, joining undesired group discussion forums, downloading irrelative object for a specific topic . . . etc. However, currently, learners intend to use LMS that allows adapting a customized layout of LMS, or enabling to choose the learning method

through different types of learners' interaction with the LMS.

1.2 Intelligent tutoring systems vs. human tutoring

Professional human tutoring is most commonly known as the most effective form of education. This is reasoned by effective multidirectional communications between learners and human tutors. In a comparison between the human tutoring and the intelligent tutoring systems for learners doing the same topic, learners working with expert human tutors often score double the intelligent tutoring system [6, 7]. In order to equip the LMS with intelligent interaction tools, a number of dialogue-based tutoring systems have emerged that attempt to mimic the dialogue strategies of human tutors [8]. However these dialogue-based tutoring systems do not count learners' preferences through these communications. Counting these preferences would help them to fully invest the resources and features available, and to succeed in achieving the learning outcomes. In order to personalize the LMSs, LMS system designers should make their systems personalized enabled by add adaptability features that makes the LMS intelligently adapts learners' preferences.

Intelligent personalization of LMS is the system responsible for integrating all learning services and intelligently adapts learners' preferences during performing any learning activities. Despite the fact that all LMS use common ways of presenting learning objects and performing learning activities remains, individual learners have his or her own individual learning preferences [9]. In this context, LMS can be seen as key elements of the learning process through interactive learners' collaborations, interactions, and knowledge constructions as discussed by Lonn [10]. Personalization is in this case is based on interactive learning styles and theories. The interactive personalization requirements would put a high pressure in order to choose the right software that allows personalizing the LMS they use. The interactive personalization requirements would put a high pressure in order to choose the right software that enables the LMS in use to adapt the personalized preferences.

1.3 Current adaptive intelligent learning systems: implementations and weaknesses

A recent Adaptive Intelligent Learning System has been implemented by Serc et al [11] as a multi-agent system as ontologies used in agent communications. The work presented by Serc et al [11] presents an Adaptive Intelligent Learning System (AILS) designed to be used with any Learning Management System (LMS). Despite current adaptive systems are designed to use advanced intelligent agent technologies [17], yet these systems is not fully monitoring the learner's learning preferences as a recorded learning style. The adaptiveness provided by these systems identifies the learner's learning process not the learner's learning style. Records keeping counts the steps of assignment submissions, type of e-object required for downloading, people involved in group meetings, mode of exchanging updates, and willing to receive the grading and feedback . . . etc. Hence, successful agent based systems require considerations of cognitive theory for implanting human-like brains in the computer systems so that communications with these systems are human like communications. Meanwhile, current adaptive intelligent learning management systems yet have largely ignored working on cognition inspiration into the communications [12].

1.4 The Need for personalization in current LMSs

The need to propose personalized LMS design requirements dues to the following factors:

- First, in traditional classroom format, a teacher modifies content-related activities based on the various levels of learners' capabilities and learning preferences [16]. This is reasoned out by the fact that teacher-learner high communications. However, due to the lack of adaptive interaction tools in the current LMSs, LMSs do not learn about the learner like the teacher does.
- Second, current uses of LMS technologies in teaching were limited to distributing the course objects, announcements as well as other services like: downloading object, uploading object, and online tests and quizzes.
- Third and inspired by the fact that communication is a key form of interaction, learners have their own learning styles and hence this emphasizes the need for personalization from the learners' perspectives. Learners nowadays are not interested in browsing all course contents whilst performing a download task for some object. Learners also can be interested in accessing only the desired part of the object they need [18, 19]. This would require an intelligent shell that allows a quick access with few clicks. Alternatively, a learner might not like cooperation with ALL class mates, but only desired group. Other services should be links in the learner's home page to announcements or new assessment activity like quizzes [20, 21].

To sum up, the purpose of this research is to provide design requirements for designing personalized learning management system. This proposed design based on adapting a set of recorded learning styles utilizes the communication and collaboration features. According to the results shown graphi-

cally, most of the learners found the system quiet helpful in being fully connected to the course instructor as well as their peer learners.

2. Methodology

2.1 Identifying learning styles in light of learning Tools in LMS

Currently available LMSs provide a collection of tools and features to support personalizing teaching and learning processes. Personalizing learning tools usually include: online group discussion, homework collections and grading, discussion forum and chatting, online tests & quizzes and teacher's evaluation. Figure 1 presents the common learning tools available in the LMSs are discussion tools, chat rooms, wikis, and blogs are available to help learners to interact among themselves without teacher intervention to complete work as projects, paper, or presentation. Other tools such as 'Discussion Board', 'Forum tools' are tools that ensure performing learning activities such as group collaboration, the sharing of ideas, forums. These channels are considered aid tools to help weak learners to follow up with their peers through discussion boards features. In addition, Fig. 1 also represents other tools that support learners' communication

through the 'Questions and answers' tools to interact with each other. This is a very important communication tool, as it allows learners to exchange their experiences through the 'saved questions and answers'. This is quite important dimension in the modern learning theories, commonly known as peer learning, as it significantly influences learner's achievements. Teachers can also use the saved 'question and answers' tools to address common problems the learners face by picking common questions the learners raise during exam preparation and assignment solving. Teachers and learners can work together to collect and respond to questions using Questions and Answers.

2.2 Learning activities and associated learning styles

This section demonstrates the recorded learners' preferences that are supported by the current LMS services; used by a set of learners at different levels. These preferences represent the identified learning Styles, presented in Figure 2, that allow for better serving and facilitating uncommonly successful task performance for the most common of the required teaching-learning activities [14, 15]. Accordingly, the e-content provided in that kind of system should be considered in designing the intelligent
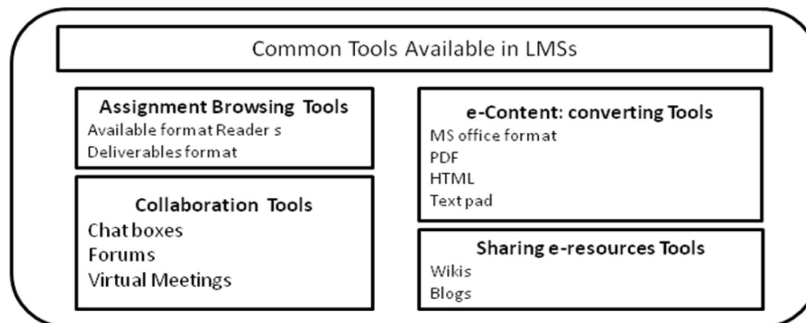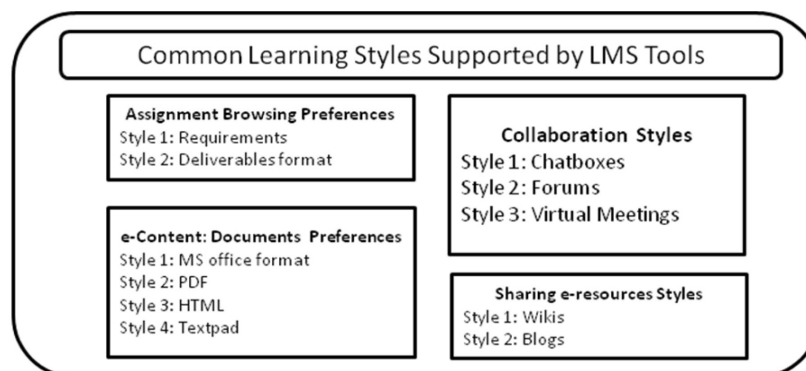

Fig. 1. Common tools available in current LMSs.

Fig. 2. Common learning styles for different learning activities.

Table 1. Learning styles for Assignment learning activity

Learning style	Activities
LS1: Forums	**Group mode**: Uploading the assignment for the entire class, dividing the questions for different student groups, submission of answers with explanation by different groups, sharing the answers with the whole class.
LS2: Assignments	**Individual mode:** instructor uploading assignments using assignment tools with specific submission date, students submitting the answers through assignment tool adhering the submission dates.

Table 2. Learning styles for 'Assessment: Online Tests and Quizzes' Activity

Learning style	Activities
LS1: In-campus Tests & Quizzes	The secured exams are created by the instructor which must be taken during class time.
LS2: Off campus Tests & Quizzes	The secured exams are created by the instructor which must be taken off campus at specific class time.

Table 3. learning activity Learning styles for group project

Learning style	Activities
LS1: Forums	Joining desired group using forums for group communication: Uploading the document, reviewing, commenting & revising the document by the members, Uploading the latest version by any group member.
LS2: Chat Boxes	Joining desired group using chat box by any group member who logged into the system, discussing & commenting on the project. Reading the recorded discussion after the chat the session by any of the group members.
LS3: Drop Box	Using drop box features for one-to-one communication: Uploading the document by a member in the drop box of the desired group member for reviewing.

system that integrates these preferences and identify them styles associated with each learner ID.

In order to fully adapt the recorded learner's learning style during different learning activities presented in Tables 1, 2 and 3, the learner's preferences are tailored instantly by integrating various components such as course e-contents, choices and learner's preferences. This adaptation would ensure multi-communicational channels that cover all learning format:

- Regular download, upload,
- Viewing, asking questions,
- Meeting peers,
- Reviewing frequent asked questions related to the assignment or specific part of the course.

The current form of Learning Management Systems provides an effective service, but the integration of Intelligent Systems (IALMS) with Learning Management System (LMS) would make learning more effective and efficient.

2.3 Design requirements for intelligent adaptation learning management system (IALMS)

The design for an IALMS requires considering multi communication channels for learning. These channels as presented in section ?3 shall be accomplished by updating the existing characteristics of LMS with the features of Intelligent Adaptive System to build Intelligent Adaptive Learning Management System (IALMS). Intelligent Adaptive Learning Management System (IALMS) is a Meta level software required to assist teachers in recording learners' styles. These systems learn through the experience and improve its performance based on the stimulus and responses take place in the system The ILMS continuously record any process involved during the learning such as choosing files format, selection of media, interaction method regarding the collaboration, and cooperation with peers. The recorded information collected at every use is processed by the integrated Meta level of the LMS to learn about the learner. While providing new content to the learner, the system considers all the factors that were tracked earlier; from the day learner registered to the most recent learning process. The learning style then is identified and stored along with the learner ID and personal information. Next time when the learner signs in he/she will be offered this shortcut to the desired action. This would be interactive style that could be modified and would be more suitable to that individual than a predefined style.

Original course content is one or more components/parts of e-content such as text, images, video, animation and simulation. Personal choices are the
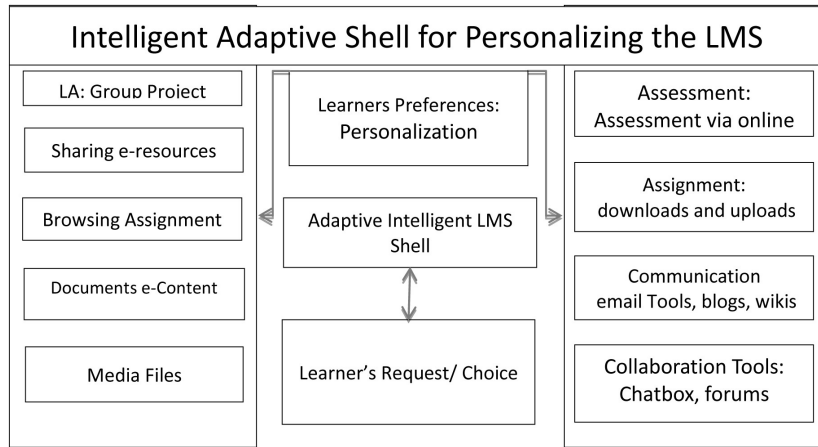
Fig. 3. Intelligent Adaptive Shells for Personalizing the Learning Management System.

selection of media, learning methods, interactivity and other special features available in the system. Learning experiences are pace of learning, grades achieved, language used during conversations and kinds of interaction mode.

In this context, Fig. 1, the IALMS receives the request for an e-content from a learner. When the learner signs in the LMS, the IALMS processes the recorded LS associated to the learner in order to offer an appropriate modified learning content. The recorded LS perform content modifications that are the integrated content from original course content.

3. Discussions

Upon request being sent by the learner, for example a learner wants to learn a topic in a specific course, the intelligent shell automatically selects the avail-

able style about previous knowledge of the learner in this specific course. The previous knowledge in this course is retrieved from recorded earlier experiences such as documents format and browsing preferences (Lecture notes, power point slides, extra readings) and updates (announcements, extra supplementary object added) and/or grades obtained. In addition, the previous learning activities such as forum discussion, journals read, enquires on chat, interviews listened and demonstrations watched are considered.

Finally, based on the engine's result, a suitable content is offered to the learner. But the learner is also facilitated to override the choice opted by the system. If the learner wants to work on another course in which previous experiences doesn't exist, the new content is offered by considering the past mode of learning chosen for other courses. Mean-
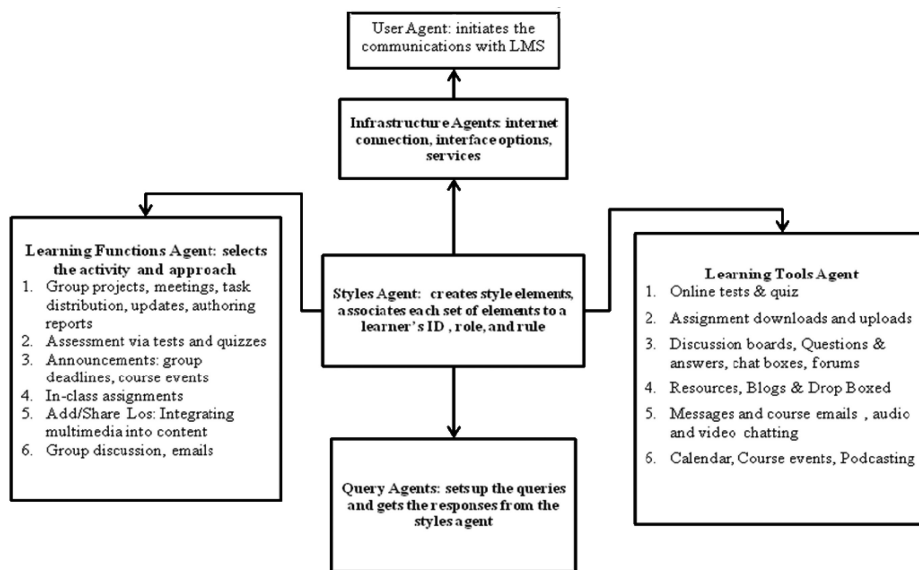

Fig. 4. Agent Based Architecture for the Intelligent Shell.

while, learners will be allowed to have the option to change, modify or select new preferences for the new course. Hence, the learning preferences on this new course are recorded and savedin the system. An advantage of such design requirement allows the learner to learn according to his/her own way as if learning all courses from one teacher.

4. Conclusions

This study aimed at publishing the findings of the case study of implementing the LMS in various teaching-learning activities using services provided by the LMS. The learners results at the end of the second semester indicate that the LMS systems provide excellent tools including discussion boards chat sessions, and other collaboration tools. One of the most important outcomes of using the LMS is that it allows the learners to personalize the learning tools available on the system to serve the specifics of each teachers based on the nature of each teachers. In order to facilitate teachers' uses of a technology system, LMS system designers should make their systems easier to learn and use, add interoperability features with other technology systems, and incorporate more functions into their system that are tailored to various course areas.

Monitoring learners' preferences during the above mentioned study has indicated that learning styles can be recorded by the system and associated to the learner's ID. The effectiveness of having intelligent adaptation by the LMS of these styles supports teaching-learning process. IALM performs the teacher's job; i.e. modifying the learning contents according to each learner learning style. This in turn would help in providing flexible educational approaches.

Adding intelligent shell as integrated software that improves efficiency of using educational technologists would produce more innovative and flexible learner centered educational environment. This can be detected from having learners expressed their willingness to have their own learning style that allows learners to learn as if they are learning from the same teacher. The requirements recommended by this study for designing LMS results in the following recommendations to be put under consideration when designing intelligent system.

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