Devising and Analyzing Expert Based Learning Methodology

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***Abstract* – The focus of this research is to devise and analyse Expert Based learning Methodology and further compare its impact and benefits with the traditional academic learning. In order to realise this, review and comparative analyses of adaptive learning environments has been done. The intersection and combination of the insights from the reviewed and analysed concepts have been used to Develop Mobile Expert Learning Knowledge Management System. The expected impact is in improving learning knowledge transfer and performance and this system to open the doors for the community, who are interested in self learning and accessibility in real time and without constrains in time of delivery of content. Also contribution of the study is the PMQ (Performance Measurement Questionnaire) that is used for evaluating not only learning but also for developing performance measures.**

***Keywords* – Expert based learning, knowledge management, m-learning, mobile devices,**

1. Introduction

Research into mobile applications to be used in learning known as m-learning intersected with best insights and state of the art achievements from adaptive learning theories can place Universities and other institutions at the forefront of pedagogical excellence of learning practice, answering learners requirements for flexibility and ubiquity: 'anywhere, anytime, and any device' access to information.

The technology oriented economy of the 21st century focuses on sharing, organizing, managing and creating information [7]. This indicates that competition is driven by knowledge revolution in the future.

Expert based learning is something that is not researched and represents a very interesting opportunity of enhancing mobile learner's knowledge management and problem based skills.

Integrating knowledge management into practical educational activities and especially combined with adaptive learning applied in mobile learning using the proposed Expert based learning (EXBL) methodology as approach according to user feedback and Performance Measurement Questionnaire (PMQ) has shown effective solution that can improve the knowledge transfer substantially.

2. Background Research on Learning Modelling Approaches

In Software Engineering mobile learning software there is evidently a lack of support for instructional techniques and pedagogical learning models, as well as procedures or guidelines how, when and for what particular situation each pedagogical learning model should be supported in the software development process and its conjunction and correlation with the instructional strategies [1] .

Instructional strategy is a very important concept that needs to be addressed because the main purpose of any learning activity should be clear to the learner [1].

Instructional design models typically specify a method in using the technology that if followed will facilitation of the transfer of knowledge, skills and learning process [7]. This learning dimension should provide the context of instruction and desirable outcome. The learning environments require high level of self-organization and metacognitive abilities from the learners engaged in the process of learning that should be captured by the instructional techniques.

There are several instructional strategies that are currently considered: Problem Based, Project based, Inquiry-based Learning, Task based and Game based learning [6] .

Problem based learning represents the learning that results from working with problems that needs solving. The entire learning process is set around a problem introduced and the knowledge is developed as a consequence of trying to solve the problem.

Generally described as “an instructional strategy in which learners confront contextualized, ill structured problems and strive to find meaningful solutions and learn in the process of doing it.” In general it is an approach to learning focusing on the process of solving a problem and acquiring knowledge. The approach is also inquiry-based when learners are active in creating the problem. The learners are elevated to the position of analyst and problem-solver and have specific objectives and deadlines to meet. According to[7] there are two critical issues involved in presenting the problem. First, if the learners are to engage in authentic problem solving, then they must own the problem. A second critical issue in presenting the problem is to be certain that the data presented does not highlight critical factors in the case. Either the problem must be richly presented or presented only as a basic question. Learning should be synthesized and organized in the context of the problem.

Project-based learning (PBL) is a model that organizes learning around projects. Definitions of "project-based instruction" include features relating to the use of an authentic ("driving") question, a community of inquiry, and the use of cognitive (technology-based) tools [10]. Project-based instruction is an authentic instructional model or strategy in which learners plan, implement, and evaluate projects that have real-world applications beyond the classroom [10]. Projects sometimes go off track, with teachers and students pursuing questions that are peripheral to the subject matter of interest. The solution, according to [10] is to find ways for projects to center on "learning appropriate goals."

Inquiry-based Learning according to[7] represents an instructional strategy were involvement in learning implies processing skills and metacognitive abilities in order to seek answers to questions and issues while at the same time constructing new knowledge. "Inquiry" is defined as seeking information by questioning. According to[7] it usually begins with posing a problem or question, followed by generating and pursuing strategies for investigating, collaborating, reflecting, and justifying the solutions of the problem or answers to the question, and communicating the conclusions.

Task-based learning is an educationally sound, effective and efficient instructional strategy for learning focusing the learning activities around tasks. The term "task-based learning" according to [10]originated primarily from the work done in language education. According to [10]the learning tasks play a fundamental role in determining the learning outcomes. According to [10] it has three advantages:

1. Learning built round tasks is more effective than traditional didactic memory-based or purely apprenticeship-type learning;
2. Learning structured round the tasks is an efficient approach to learning;
3. Task-based learning is likely to lead to more relevant and appropriate education.

Task-based learning offers action and reflection, while in contrast, rote learning is low in action and in reflection. According to [10]incidental learning, such as occurs in on-the-job learning, is rich in action but may be low in reflection. Classroom, or formal, learning is frequently high in reflection but low in action.

Game based learning or also lately referred to as digital game-based learning [10] goal based scenarios and instructional games and simulations are alternatively used to describe the instructional strategy were learning activities are organized around a game or simulation. The academic community regarded game based learning as part of problem based learning using simulations and did not give much of attention in its research, and still today there are a lot of opinions in this regard[7] . Educational games and simulations are defined as activities that have rules and constraints, a goal, and an emphasis on competition and also has the additional feature of having a primary objective of enabling a student to learn either facts, skills, attitudes, or all three. [7] and[7] suggests that transfer of knowledge is aided when students actively construct explanations for events. Perhaps the biggest benefit for game -based learning is the fact that it involves students who need to learn complex skills and need to transfer these skills to real life.

The design and development of m-learning cannot be based only in the existing practice of technology, it is necessary to understand the relation between theory and practice to ensure that the design

of practice is founded on the learning theory. This concept defined in [10] is given in the figure below:

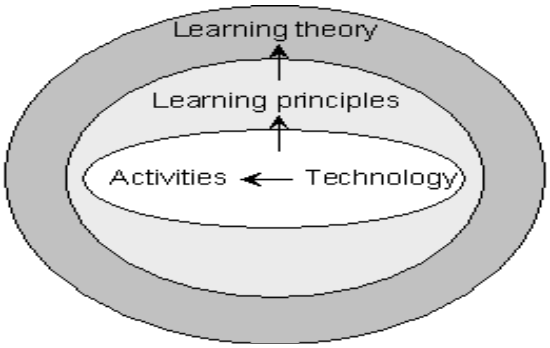

Figure 1. Theoretically grounded evaluation of technology [10]

It describes that the different learning activities that are driven in the learning environment are supported by the m-learning instructional technologies stated above. The learning principles are formed by the learning activities to be done to produce the learning outcome. The learning activities are crucial to define the features and abilities the learning environment has to support and are supported by the technology.

According to [1] the e-learning solutions development process adopts one of the following learning modelling approaches:

1. the content-oriented,
2. the tool-oriented, or
3. the task-oriented approach

The content-oriented approach deals with management of learning content. It is mainly concerned with supporting authoring, structuring, delivering, sharing, re-using, and querying the content [1]. The design and authoring of e-learning content requires major input from instructional designers, graphics designers, and programmers. Normally the instructors are expected to develop the content for e-learning on their own. However content creators search for a theoretical basis to justify their designs [6]. Normally the instructors are expected to develop the content for e-learning on their own. However they are not aware of the effective methods which can be used to present their content to users. Especially the novice instructors need additional support in developing interactivity since it involves programming. Support might include collaborative tools for enriching the learning content by writing comments and annotations, tools for tracking the student progress with the content, or tools for adapting the content to the students' preferences [10]. Tool-oriented approach is based on using the technological infrastructure in the learning process. Learning sessions which follow this approach are organized around the use of the developed software [1]. The developed software solution is the main vehicle into increased transfer of knowledge. This learning modelling approach provides clear support and focuses the learning process around the developed tool of instruction as medium.

Task-oriented approach deals with learning tasks or learning activities which learners need to perform in their learning sessions. Those tasks are typically structured in very simple learning sequences that the students need to pass in a sequential mode [1]. This learning modelling approach clearly support and focuses the learning process on previously created scenarios of sequential tasks that will guide the learner activities into more efficient and higher level of knowledge transfer.

3. Review and Analyses of Adaptive Learning environments

The ideal of individualized learning (i.e., learning tailored to the specific requirements and preferences of the individual) cannot be achieved, especially at a "massive" scale, using traditional approaches. Factors that further contribute in this direction are different and among others include the diversity in the "target" population participating in learning activities.

Analyzed were several projects and research initiatives that deal with personalization have been shortly reviewed. The reviewed projects are the OPen Adaptive Learning Environment (OPAL), [5] and ADELE-Adaptive e-Learning with Eye Tracking [5]. The OPAL research shows personalization as difficult to achieve and "… are often expensive, both from a time and financial perspective, to develop and maintain" [5]. Therefore, a conclusion is drown that learner personalization should not been addressed at to finely grained level. Typically, personalization at that starting level is not practical based on the findings of OPAL project [5] and since it has too include all of those learners preferences that change each time the learner uses the system clearly does not

represent a constant factor that can be addressed [3]. Instead, a recommendation is to use the defined approach with e-learning indicators as starting point when developing an e-learning initiative. Then after the measurements the learners are divided into groups so called ”collectives” (in Universities these are the departmental levels) were personalization is offered to the specifics of the collectives majority primarily based on learning style categorization and type of learner they are. We have adopted the Felder-Silverman model for learning style categorization [11]. After that learner personalization can be designed and offered tailored to each collective [5]. Furthermore, based on the measurements of these e-learning indicators a design of a sustainable e-learning initiative can be supported. Each e-learning initiative is unique and involves specifics that cannot be taken under consideration in the form of “one-size-fits-all” solution.

According to [10] there are four categories of Adaptation in Learning Environments. The first category, Adaptive Interaction, refers to adaptations that take place at the system’s interface and are intended to facilitate or support the user’s interaction with the system, without, however, modifying in any way the learning “content” itself. Examples of adaptations at this level include: the employment of alternative graphical, colour schemes, font sizes, etc., to accommodate user preferences, requirements or disabilities at the lexical (or physical) level of interaction; the reorganization or restructuring of interactive tasks at the syntactic level of interaction; or the adoption of alternative interaction metaphors at the semantic level of interaction.

The second category, Adaptive Course Delivery, constitutes the most common and widely used collection of adaptation techniques applied in learning environments today. In particular, the term is used to refer to adaptations that are intended to tailor a course (or, in some cases, a series of courses) to the individual learner. The intention is to optimise the “fit” between course contents and user characteristics / requirements, so that the “optimal” learning result is obtained, while, in concert, the time and interactions expended on a course are brought to a “minimum”. In addition to time and effort economy, major factors behind the adoption of adaptive techniques in this context include: compensating for the lack of a human tutor (who is capable of assessing learner capacity, goals, etc., and advising on individualized “curricula”), improving subjective evaluation of courses by learners, etc. The most typical examples of adaptations in this category are: dynamic course (re-)structuring; adaptive navigation support; and, adaptive selection of alternative (fragments of) course material [1].

The third category, Content Discovery and Assembly, refers to the application of adaptive techniques in the discovery and assembly of learning material / “content” from potentially distributed sources / repositories. The adaptive component of this process lies with the utilization of adaptation-oriented models and knowledge about users typically derived from monitoring, both of which are not available to non-adaptive systems that engage in the same process.

The fourth and final category, Adaptive Collaboration Support, is intended to capture adaptive support in learning processes that involve communication between multiple persons (and, therefore, social interaction), and, potentially, collaboration towards common objectives.

This is an important dimension to be considered as we are moving away from “isolationist” approaches to learning, which are at odds with what modern learning theory increasingly emphasizes: the importance of collaboration, cooperative learning, and communities of learners, social negotiation, and apprenticeship in learning (Wiley, 2003).

4. Conceptual Model of Expert Based Learning

Currently there is not enough research conducted about Expert learning especially applied in mobile devices.

Expert Based Learning (EXBL) methodology we conceptualize and define as learning in depth from expert in the field in a form of the two instructional approaches: Project Based Learning, either from his/her project or as Problem Based Learning problem in a form of problem based assignments and then interacting with the expert on a forum type system, or by answering expert questions in the form of a multiple choice quiz type, that is easier to achieve in electronic software systems.

A well-designed project provokes learners to encounter (and struggle with) the central concepts and principles of a discipline and gives a lot of insights how to approach and do something and a finished project from an expert can be extremely good source of knowledge when provided as template to learn from.

Performance is assessed on an individual basis, and takes into account the quality of the work produced, the depth of content understanding demonstrated, and the contributions made to the ongoing process of project realization.

According to [10], adaptive learning systems have traditionally been divided into separate components or 'models'. While different model groups have been presented, most systems include some or all of the following models (occasionally with different names):

– Expert model - The model with the information which is to be taught
– Student model - The model which tracks and learns about the student
– Instructional model - The model which actually conveys the information
– Instructional environment - The users interface for interacting with the system.

Conceptually for the case study software solution decided to follow the instructional approach with Problem Based Learning. This decision is based upon testing learners learning style adopted from Felder-Silverman model. In here experts assign problem based assignments as learning tasks and then the next step is to assess their knowledge and performance using what we have defined as PMQ (Performance Measurement Questionnaire).

Once the PMQ is answered and sent automatically goes to the email of the instructor and outside expert engaged in clinical teaching within the course and it has the time stamp of date and time sent. This option is provided in the settings option of the software solution.

The PMQ (Performance Measurement Quiz) is used for evaluating not only learning but also and developing measures. It is based on the premise that measures should appraise, reinforce and rewards improvements in performance. PMQ is structured into 2 main parts:

- Part 1 asks respondents to answer problem based assignment questions and asses their knowledge.
- Part 2 asks respondents to score specific performance measures, of specific improvement areas, comparing before and after the leaning process.

In overall, PMQ assesses the knowledge and performance of specific improvement areas while allowing them further development, as well as proposing new insights and measures onto an existing system.

The research study contributes with new proposed Expert Based Learning (EXBL) methodology to be used for developing m-learning applications that according to the results has been shown effective.

Also contribution of the study is the PMQ (Performance Measurement Quiz) that is used for evaluating not only learning but also and developing performance measures.

5. Expert Based Learning versus Academic Learning

According to [10], adaptive learning systems have traditionally been divided into separate components or 'models'. While different model groups have been presented, most systems include some or all of the following models (occasionally with different names):

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Currently there is no research about Expert based learning. Expert Based Learning is synonymous with learning in depth from expert in the field either from his/her project or interacting with the expert on a forum type system. A well-designed project provokes learners to encounter (and struggle with) the central concepts and principles of a discipline and gives a lot of insights how to approach and do something and a finished project from an expert can be extremely

good source of knowledge when provided as template to learn from.

Performance is assessed on an individual basis, and takes into account the quality of the work produced, the depth of content understanding demonstrated, and the contributions made to the ongoing process of project realization. On the other hand the academic learning is organised in semester (15 week) based learning were the content is provided and organised in strictly organised lectures and practical's that ensure the learning and entire knowledge is gained in the process.

6. Experiment – Devising and Analysing Expert learning knowledge management system

The focus of this research study is reviewing current research on personalization and adaptive learning as well as Adaptive Learning Environments, focusing on Expert Based learning (EXBL) methodology to be used in mobile learning.

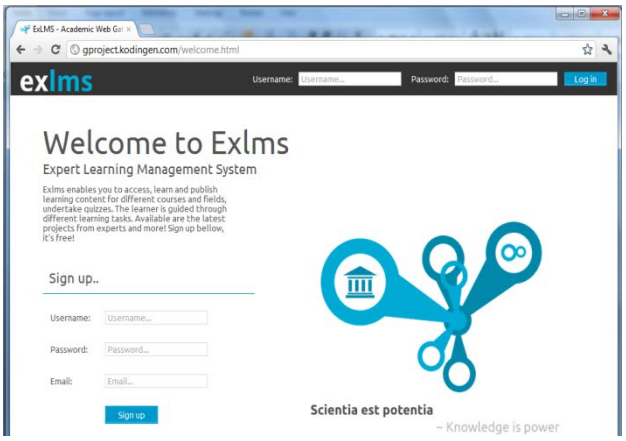

Figure 2. The interface of EXLMS Expert Based Learning Management system

In order to test the developed methodology a mobile software solution is created and tested the efficiency of the developed solution. The contribution of the research study is the proposed Expert Based Learning (EXBL) methodology to be used for developing m-learning applications. Also contribution of the study is the PMQ (Performance Measurement Questionnaire) that is used for evaluating not only learning but also for developing performance measures.

In order to investigate the Expert Based learning (EXBL) methodology that is recommended to be used in mobile learning a software solution is developed and can be found online at the following link: http://gproject.kodingen.com.

The research concept is focused into implementing EXBL- Expert Based learning scenario using the project based learning and forum and in this manner to make the interface adaptable to different instructional approaches and learning styles.

Contemporary learning theory suggests that individual learners differ in the way they learn and that learning must be tailored to the individual learner. Consequently, learning environments must have the flexibility to adapt themselves for the individual learner. According to [2], adaptive learning systems have traditionally been divided into separate components or 'models'.

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Learners in using EXLMS will be able to direct their learning by using one of the two modes that are offered: 1) learning from University Professor and instructors in academic organized manner organized in semesters or 2) learning from experts in their respective fields by viewing their published projects and problem based solutions the experts published in the system and learn by analysing experts work and communicating with them in clarifying something they need or solve some particular problem with their help. In the same manner the EXLMS will encourage on creating a "community of experts" that will be evaluated form learners as well as from their fellow colleagues.

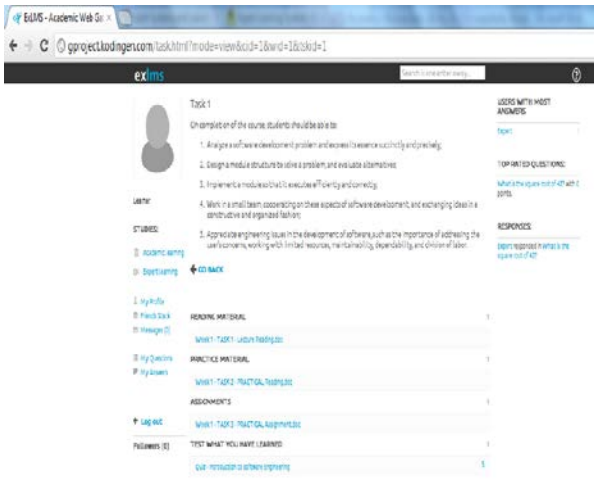

Figure 3. The learning interface

The academic learning interface presented in the figure above is supporting Task based learning, were the learner is not left alone but rather guided each week with 4 (four) tasks: reading the lecture for that particular week and then he can move to the next Task2 to read the practical part, and after the learner finishes this part can access the Task 3 which is solving a practical assignment. And finally Task 4 the learner has to undertake a Quiz that involves questions from the previous Tasks.

The system in this manner is self-sufficient in assessing automatically and independently the learners and in this manner provides them an overview of the learned content and measures their performance.

Creating expert learning systems allows the best content and content experts to respond to all learners. At the same time the intersection of Professor working with these expert systems would become progressively more capable by facilitating these systems. The more they facilitate these programs, the more expert they become. Under these conditions learning would truly be a lifelong experience.

7. Conclusion

A conclusion drawn from the experiences from this research study shows that m-learning has large potentials and that EXBL methodology embedded in this mobile software solution according to learners feedback is quite high.

This methodology attempted to resolve some of the definitional and methodological difficulties encountered by previous researchers. It involved review and comparative analyses of Knowledge Management, Mobile Learning, Adaptive Learning Environments, focusing on Expert Based learning (EXBL) methodology to be used in mobile learning.

The future work is to implement the other EXBL scenario using the project based learning and forum and in this manner to make the interface adaptable to different instructional approaches and learning styles.

Contemporary learning theory suggests that individual learners differ in the way they learn and that learning must be tailored to the individual learner. Consequently, learning environments must have the flexibility to adapt themselves for the individual learner.

The conclusion is that in the near future, it is expected that learning will move more and more into mobile devices and outside the classroom and lectures halls into the learner's mobile environment both real and virtual negotiated by mobile devices.

The significance of the research is based in the fact that almost every student has a mobile device at all times while not everyone has a computer and internet connection at all times. The excepted impact is in improving learning knowledge transfer and performance and this system to open the doors for the community, who are interested in self learning and accessibility in real time and without constrains in time of delivery of content.

A conclusion drawn from the experiences from this research study shows that m-learning has large potentials and that EXBL methodology embedded in this mobile software solution according to learners

feedback is quite high. It makes possible learners to learn at their own peace while at the same time once the quiz is sent automatically goes to the email of the instructor and outside expert engaged in clinical teaching within the course.

Moreover this approach combined with experimental approach to m-learning can bring new insights into the specifics of m-learning that might help in increasing the learning outcomes, especially knowledge transfer.

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