Course delivery and module learning via learning objects (knowledge map) in mobile learning environment

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Course Delivery and Module Learning
via Learning Objects (Knowledge Map)
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Abstract

This paper describes the architecture of using the Learning objects and Knowledge Map as the learning sequence suggestion in the mobile learning environment and explains the technologies involved, the applications and the issues of usability, accessibility, evaluation and effectiveness. In the coming years, mobile learning has open up new path for learning support and opportunities to reach wider audience (learner) for education. This research focuses on using the knowledge map to store the characteristics of each learning objects via concept schemas and represent the corresponding learning accessibility in the mobile learning environment. The proposed architecture provide a medium for the learners to retrieve quick bursts of information through mobile applications wirelessly and as an effective way to overcome the problem of heavy loading on the limited bandwidth is used in wireless transmission for mobile learning environment using mobile devices which as mobility and portability such as smart phones, PDAs and tablet PCs. The approach using the combination of "touch" and "observe" spatial learning objects provide an intelligent solution to the limitation of the wireless bandwidth by lowering the bandwidth taken up during the bursts of mobile transactions, thus improving the efficiency of mobile learning. The proposed mobile learning environment architecture consist of Knowledge Map components mainly, navigation, concept schemas and learning object path. By using these knowledge structures, this study may enhance and enrich the concept and activity of adaptive learning in different individuals and communities. The spatial Knowledge Map constructed was useful in identifying the characteristics of the learning objects (e.g. Learning Object 1: lesson with navigating sentences, Learning Object 2: lesson with navigating sentence and code explanation, etc) and automatically match the most appropriate learning content and path suitable for learners. The architecture of the platform discussed in this study using the Learning Objects approach and Knowledge Map would facilitate more widespread use of mobile learning, including in courses or module delivery of individualized learning path and learning style analysis.

1. Introduction

In years coming, where more people own cell phones than PCs and language education is a huge industry, there is potential for a booming market in mobile e-learning. While education sites aren't currently moneymakers, more sophisticated content may allow providers to charge more for bite-sized learning. Mobile e-Learning introduced the wireless teaching and learning to new the world and help if this approach is right for the organization. The focus of this research is to present the learning objects using K-Map (Knowledge Map) [1] via mobile e-Learning. K-Map is used as a tool to combine digital resources and the e-Learning environment that integrated related digital, module resources with the relationship of

knowledge turned to the form of map for better understanding of learners. K-Map can serve as a learning platform by the active work with, e.g. expert information addressed in direct bilateral exchanges or project-oriented documents. In this case knowledge is not a static supply of interlocked learning processes, but is continuously generated and associated with the actors (learners). The challenge in an information-rich world is not only to make information available to people at any time, at any place, and in any form, but specifically to present the right knowledge at the right time in the right way in an ubiquitous mobile computing environment [2]. The significance of K -Map is reflected on the integration of knowledge concepts and the right cognition and values for the learners. By using these technologies, K-Map and learning objects, the proposed architecture in this research generates various learning object navigation in mobile presentation layer and prepares the learners to observe using the aid of concept schemas. Concept schemas that stored in K-Maps consist of generic concept data structure that contains mainly the concept attributes, theory explanations, links to definitions, descriptions, examples or learning objects in e-Learning.

The goal of this paper focuses on extending the delivery of e-Learning to mobile, smartphones, handheld devices and provides additional reach to new groups of learners and with the use of learning objects. Section 2 introduces the K-Map and K-Map's roadmap including learning objects, transition of Relational Data Format (RDF), and navigation path in mobile e -Learning. The navigation path represents the process of grouping, association of the learning objects and spatial K-Maps based on the research result. K-Maps generation is further elaborated in Section 3 with the framework used in mobile presentation layer. Section 4 uses the module of problem solving in programming as the evaluation module delivery and the mobile e-Learning is implemented to demonstrate the results. Section 5 presents the conclusion and future work.

2. Knowledge Map in Mobile e-Learning

In mobile learning environment, K-Map [1] assists in acquiring relative content presentations and build corporative knowledge path to enable students to learn more effectively. K-Maps are node-link representations in which ideas are located in nodes and connected to other related ideas through a series of labelled links or learning objects in the same domain or learning module. K-Map is differing from other similar representations such as mind maps, concept maps, and graphic organizers in the deliberate use of a common set of labelled links that connect ideas. Links have arrowheads to indicate the direction of the relationship between ideas.

Since e-Learning techniques have grown quickly nowadays to complement the conventional learning system, integration of K-Maps and learning objects has been a tendency to improve the creation, organization and delivery of a learner-oriented knowledge management system (KMS) in mobile e-Learning environment. K-Map can be used as primary sources for knowledge mapping, adjunct aids to navigation processing, organization of ideas, and story-board assistance in e-Learning.

Integration of K-Map in knowledge management tool with mobile e-Learning helps learners to discover the knowledge. We can use it as a knowledge collecting mean to gather knowledge from database and do the codification of knowledge. To construct a K-Map, first we should collect the ideas from the information resources; second we collect the information that the knowledge maps needed, last we give the ideas and the information orders and combine them.

The K-Map implemented into mobile e-Learning combines several knowledge oriented information systems mainly [2]:

- Transition of flexible learning, individualisation (Learning wherever and whenever one wants to)
- Individualisation of learning (Self navigation of necessary learning objects or components by individual learning format)
- Course interactivity (Learning environment with direct access and communication with course provider and peers in real time)
- Transition of Relational Data Format (RDF) via Knowledge Management Systems (KMS)/Content Management Systems (CMS)
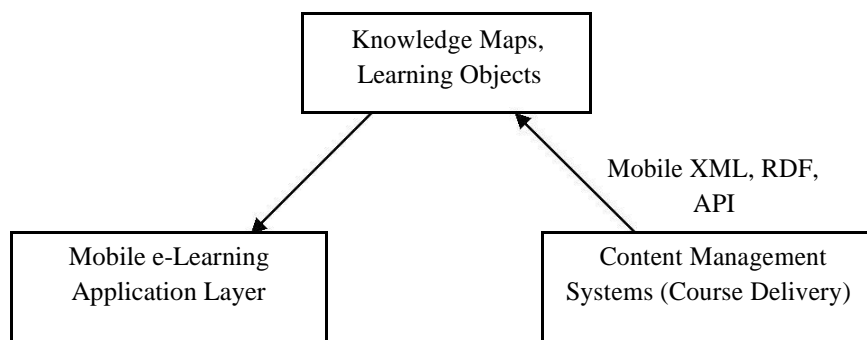
```
          ┌─────────────────────┐
          │  Knowledge Maps,    │
          │  Learning Objects   │
          └─────────────────────┘
         ↙                     ↖
                        Mobile XML, RDF,
                             API
┌─────────────────────┐   ┌─────────────────────┐
│  Mobile e-Learning  │   │  Content Management │
│  Application Layer   │   │ Systems (Course Delivery) │
└─────────────────────┘   └─────────────────────┘
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Figure 1: Roadmap of K-Map and learning objects in mobile architecture

Learning Objects in Mobile e-Learning

The proposed architecture in Figure 2 below consist of knowledge map and learning objects that compromised the navigating system generating various types of learning objects based on relational schemas and concept schemas.
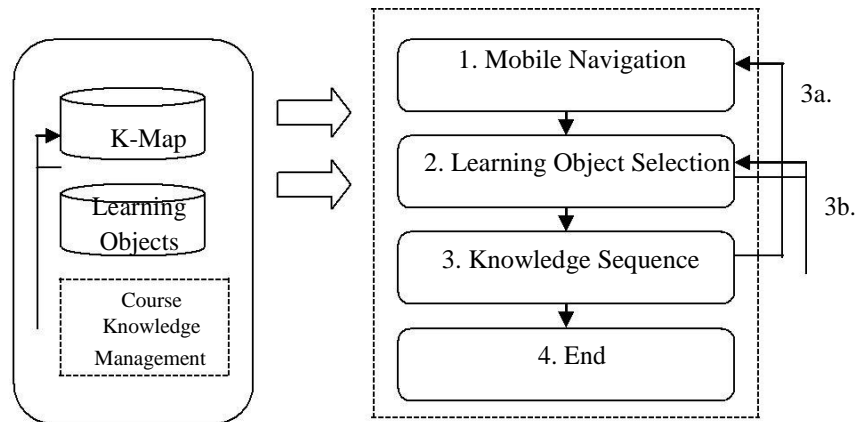

Figure 2: Course delivery sequence via mobile e-Learning using K-Map and learning objects

Figure 2 depicts the flowchart of the navigation using mobile e-Learning environment with the implementation of K-Map and learning objects. The first two steps, step 1 and step 2, are locating the suitable learning path through identification of relational schemas, concept schemas and related learning objects from K-Map. The navigating system generates human readable navigation sentences for students in step 3. If there is no further learning objects needed to learn, the navigating system goes to the end step, step 4. If there is any other learning object that is required for learning in the same learning spot, the system goes back to step 1 "Mobile Navigation" via step 3a. and, if there is any other learning object that is required for learning but locates in the other spots, the system goes to step 2 "Learning Object Selection" using step 3b.

Table 1: Comparison of Related Research in e-Learning Systems

	Mobile e-Learning	K-Map Mobile e-Learning	Moodle
Descriptions, Features	Handheld learning platform with dynamic web contents	K-Map in mobile e-Learning is introduced the concept maps in order to achieve meaningful learning for learners.	Moodle is a Course Management System where it is easy to develop, maintain and use through the modular manner.
Learning theory support	Dynamic pages	Dynamic pages, Meaningful learning	Dynamic pages, Constructivism
Concept maps support	No	Yes, Concept Map, Learning Objects	No
Specification support	SCORM, IMS	SCORM, IMS, RDF	SCORM, IMS

3. Constructing Knowledge Maps in Mobile Presentation Framework

In mobile learning environment, K-Maps application for knowledge presentation is proposed to enable learners with the multi-level navigation and collaborative interaction. In this section, we will discuss about how to achieve those goals via displaying and implementation of managing knowledge maps.
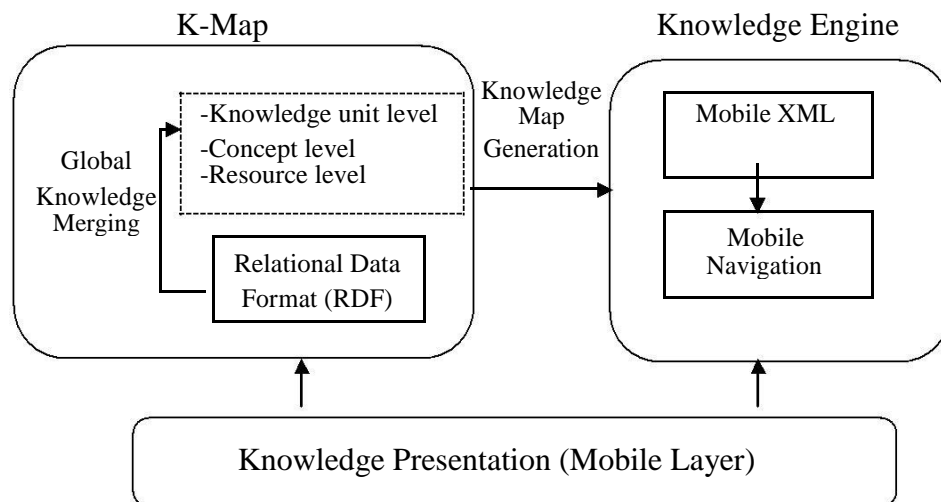

Figure 3: Proposed Framework of K-Map implementation

In Figure 3, the K-Map presents the acquired knowledge of concepts and knowledge resources with inherent association at different level [4]: the concept level, knowledge unit level and resource level.

The concept level is similar to ontology which presents the domain concepts and concepts' relations. The knowledge unit level [3] is composed of knowledge units and knowledge units' cognitive associations, i.e. the "pre-order", "analogy" or "illustration" relationship between knowledge units. The knowledge unit level also bridges the gap between concepts and resources, as knowledge units are connected to their core concepts in the concept level, and connected to their occurrences at the resource level. As the facility of providing mutli-granularity, multi-level mode for e-learning, knowledge maps should be designed to be beneficial for both knowledge presentation and information management. The following criteria [2] were adapted for spatial K-Maps module creation:

- K-Map navigation: this application provides learners with a knowledge map based interface (Instructional Management System, IMS), which enables them to navigate through the inherent associations of domain knowledge, and pinpoint their learning objective through the knowledge unit, concept and resource level approach.

- Collaborative Relational Data Format (RDF) construction: Global knowledge maps can be enriched by allowing users to create knowledge maps on local resources in RDF format. K-Map generation is designed to eliminate manual annotation that enable learners to improve the quality using the three level of knowledge map extracted from RDF.

- K-Map merging: When reviewed and accepted the user-created knowledge maps, they can merge those local knowledge maps into the global knowledge protocol. During this process, duplicated nodes and edges will be automatically eliminated.

The K-Map structure consists of concept schemas [5] as shown in Figure 4 below. Concept schema is the generic concept data structure in memory which stores the concept attributes and links to definitions, descriptions, examples or learning objects. The links that connects each concept schema is known as relation schema. The hierarchical relationship of *Java Programming* from upper level (theory) to lower level (practices and code executions) is shown in Figure 4.
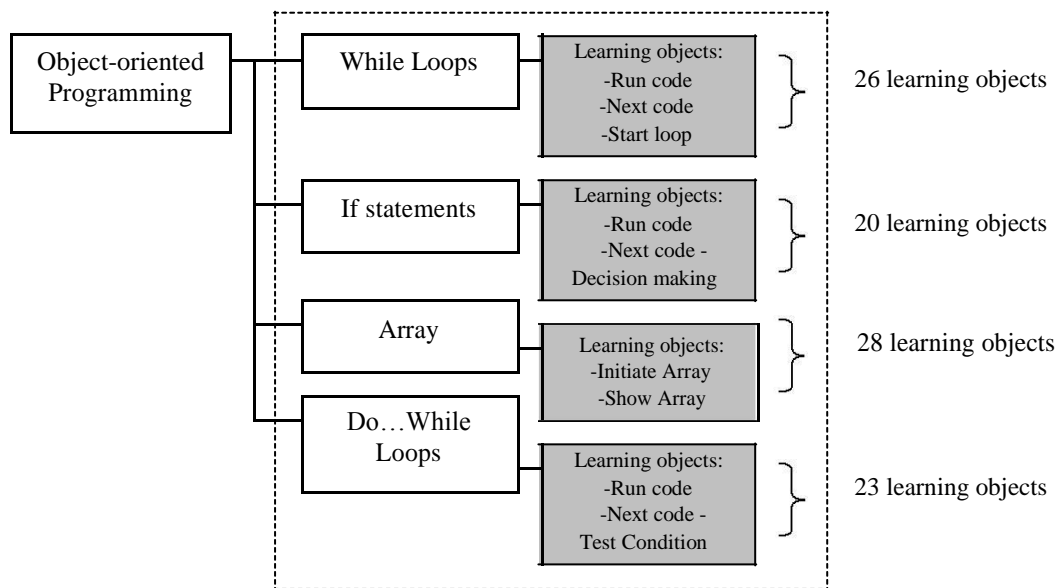
Figure 4: Knowledge map structure constructed using concept schemas

4. K-Map Implementation and Evaluation in mobile e-Learning

In the implementation of mobile learning environment, K-Maps application for knowledge presentation is proposed to enable learners with the multi-level learning object path and collaborative interaction as K-Maps are capable of guiding learners with the inherent associations among knowledge within different granularities composing of different chapters specify by the knowledge content provider. In this section, we focus on describing how the development of system can be achieved meaningful learning from theory to practice through the K-maps and learning objects in three tier surrounding. We divided the system into three tiers. There are the instructional tier, learning tier and technological tier, which are described, respectively.

Instructional tier [6] emphasized that the better instructional qualities are based on theory of instructional design, context and resources. In terms of authors, they are responsible for integrating the knowledge-creating process into instruction. It facilitates the author to make suitable instructional concept maps through the concept maps of a spatial learning domain. In the instructional tier, problem-solving learning,

collaborative learning and resource-based learning, which are associated with concept maps in specific learning module were created. Therefore, they will produce a learner-centered instructional process through systematic design of instruction (i.e., analysis, design, development, implementation and evaluation). Figure 5 below show the instructional level that consists of courses information (i.e. CourseID, CourseName, LecturerID, TutorID). Authors acquire feedback from concept maps made by learners to improve their instruction.
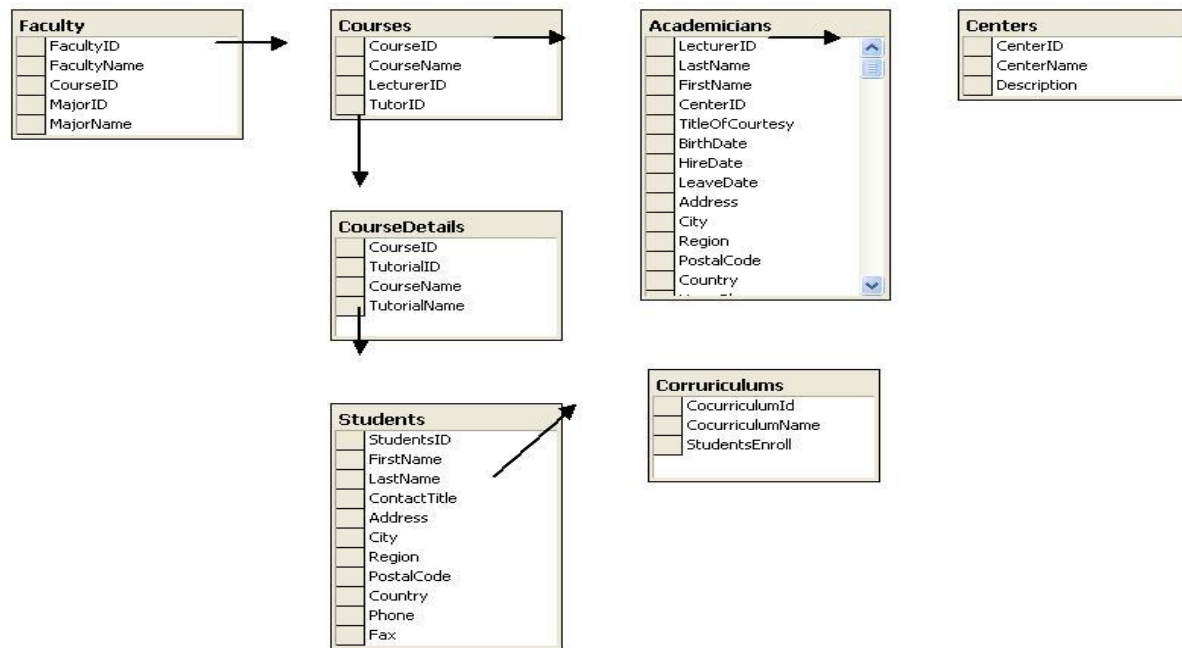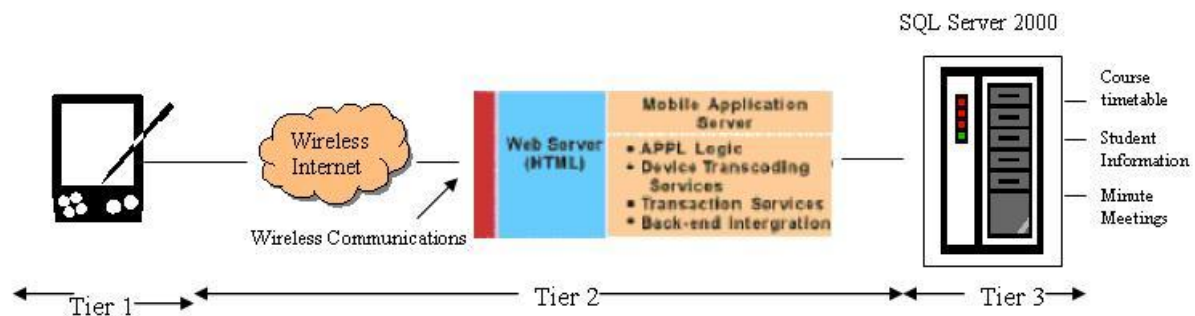

Figure 5: Mobile e-Learning Database Central

Figure 6: Learning tier and technology tier in Mobile e-Learning Architecture

Learning tier [3] emphasized that the better learning qualities are based on the five attributes of meaningful learning. In terms of learners, they utilize the concept maps to study knowledge, facilitate thinking, clarify misconception, and evaluate learning effort. In technology tier, the learners emphasized that utilizing existing technology of learning to support above three tiers which can be implemented successfully. Then, we adopted the unified process (UP) [3] to realize the KMLS in practice.

Figure 7 below depicts the learning object for "while loops" in problem solving technique as the fundamental concept in *Java Programming*.

Figure 7: Mobile e-Learning with K-Map
(Example of learning objects created within the page for "while loops")

In this section, we focus on a specific knowledge domain, *Java Programming* and use concept mapping to identify key concept, sub-concept, generalized concept, non-generalized concept and show the relationships between them, which are formed concept maps of a specific domain. The K-Map linking process can transform the knowledge assets and learning objects in Table 2 (i.e. code execution, navigation sentences) into the instructional design, context and presentation as depicted in Figure 7 and Figure 8.
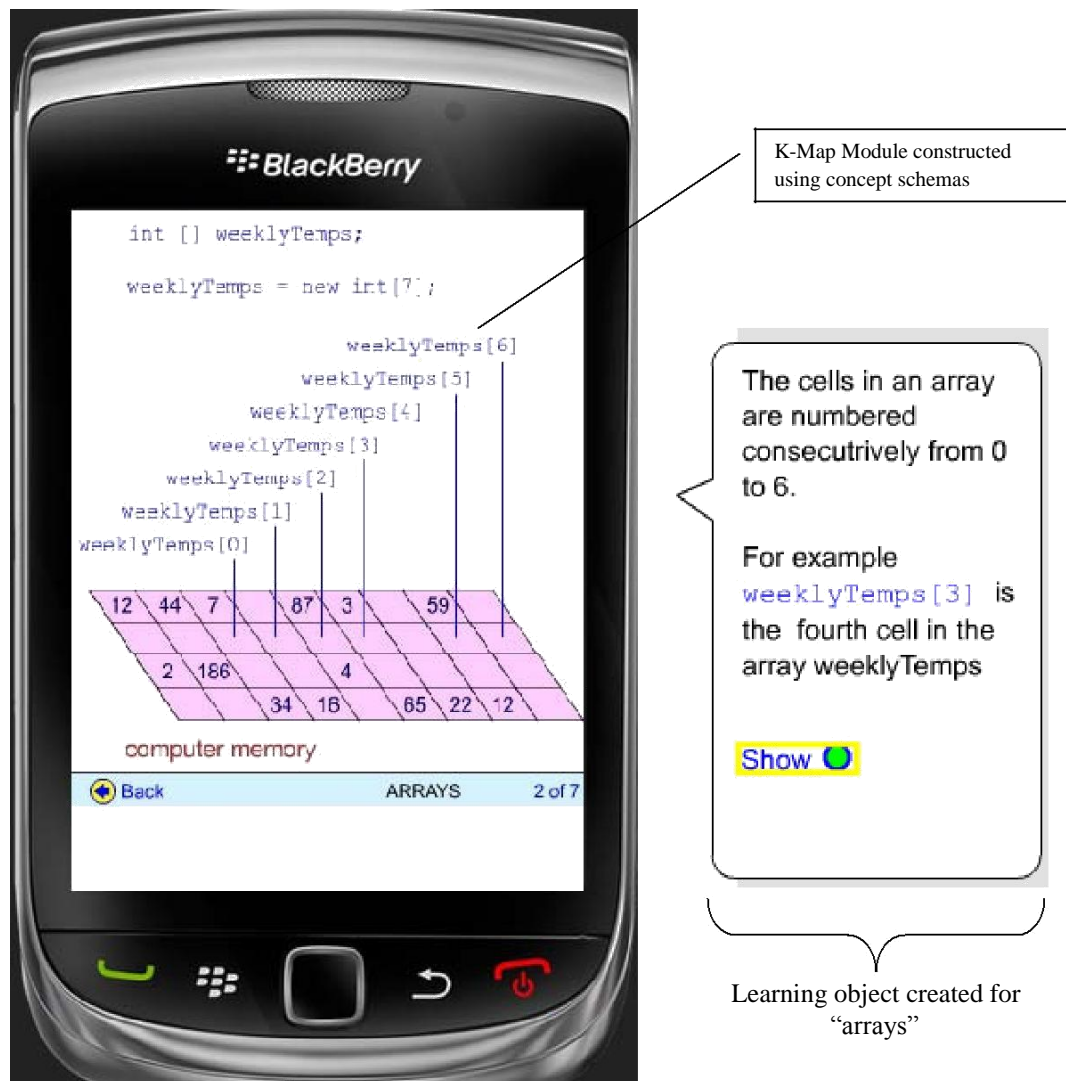
Figure 8: Mobile e-Learning with K-Map
(Example of learning objects created within the page for "Arrays")

Table 2: Learning objects constructed using Knowledge Maps within the learning modules

Learning Modules	Number of K-Maps	Number of Learning Objects
While Loops	25	26
If Statements	21	20
Arrays	31	28
Do…While Loops	24	23

5. Conclusion

Transactions in mobile e-Learning may be managed by using dynamic KMS but this is not sufficient. This paper described how a K-Maps and Learning Objects may be implemented to enhance the learning experiences and module learning in the wireless environment. Mobile e-Learning is a new trend of e-Learning which will be essential to education organization by implementing suitable concept and relational schema architecture in wireless transmission. It is the demand to maintain and manage a large amount of data in an education organization efficiently that has made the emergence of mobile technology necessary. The approach using the combination of both K-Maps and Learning Objects plays an important role in mobile e -Learning. It provides an intelligent solution to the limitation of the wireless bandwidth by lowering the bandwidth taken up during the bursts of mobile transactions. It is hoped that such approaches would facilitate more widespread use of mobile e-Learning, including in group discussions between learners, course participants and academicians for second opinion and research.

6. Future Work

The future work involves the deployment of competency assessments onto mobile phones for more courses delivery, capturing the assessment output including learners' feedbacks and synchronizing back into the student's web based e-portfolio. This assessment was then reviewed by the course provider with feedback and mapped against competencies achieved in mobile e-Learning environment. Mobile learning may not always be of value, and sometimes your materials may not be suitable for display on a mobile phone. However in many instances this delivery models that incorporate learning object path and is becoming increasingly popular.

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