CHAPTER 2

REVIEW OF LITERATURE

Review of literature is a systematic search on previous research studies in a particular topic. It is a quest for research findings apart from the textbook facts and figures. According to K.Gopalakrishnan (1987), it is a never ending process. This assists to a researcher to identify the place from where he has to start his present research, trace out his research area, and identify the research problem. Moreover, it provides a strong theoretical background on the subject matter of a research. It facilitates the researcher to ascertain what has happened in his research topic. It provides record of findings, suggestions and recommendations made by the previous research scholars. The present research scholars can understand their standing on their research and it is possible to know the research gap in this area of research. Therefore, the review of literature is imperative to all types of researches.

The present chapter provides the research findings on the AeL in chronological order.

Felix Modritscher et al (2005)\textsuperscript{15} have conducted a two-year research project carried out in the Department of Information Design at the University of Applied Sciences and the Institute for Information Systems and Computer Media at the Graz University of Technology, Austria in order to develop and

implement a solution framework for personalised adaptive e-Learning that is based on real-time user behaviour. And the authors tried to bring out research on comprehensive adaptivity in the field of e-Learning and to develop an innovative framework for personalised adaptive e-Learning. The research examined theoretical principles at first and the possible realizations of adaptivity in terms of technology-based learning as well as teaching in the class rooms.

According to them, adaptive e-Learning consists of two adaptation circles i.e, teaching process and learning process. Nevertheless, an adaptive e-Learning environment also had to consider financial aspects like the transferability and reusability of e-Learning contents. On the basis of these reflections, the researchers explained possible adaptive approaches, the consequences for an effective e-Learning standard as well as an exemplary enhancement of the SCORM standard for the benefit of the learners.

In their view, althoughSharable Content Object Reference Model (SCORM) partially fulfills the requirements for adaptive e-Learning, it has to be extended by other specifications covering the missing aspects of adaptive e-Learning. As far as the existing e-Learning specifications, are concerned it is important to consider downward compatibility to guarantee that the e-Learning content still is usable in other systems. The authors conclude that it applied the SCORM as pointed out and design the architecture of the system on the basis of the extended specifications. Due to necessary features like the XML transformation for assets or alternative assets for one SCORM, it is sure that the system’s architecture has to be very flexible to adapt to alter specifications in a fast and easy way.
Daniel Burgos et al (2005) gave an overview of a number of approaches, definitions and features of adaptive learning in their research paper. Their main aim was to make out how adaptive features and elements could be addressed by IMS LD, detailing a number of example Units of Learning which illustrate adaptation in different ways. They tried to attain the right balance between efforts given and results obtained.

The authors strongly suggest that the IMS LD can be used to represent a wide-variety of approaches to adaptivity in e-Learning. By using the specification as a language into which adaptation strategies could be exported would allow for comparison of approaches adopted by different research groups. And support for the imparting of adaptive Units of Learning into adaptive engines would allow additional application of adaptive approaches, helping to reveal any implicit assumptions and promote a shared understanding of the what, why and how of adaptive e-Learning. The research has found out that the current state of the art in IMS LD editors make the creation of adaptive UoLs technically possible, but the process is a complex one. A learning designer is required to know the technical editors in depth and to have keen knowledge of the specification. Currently, this means a remarkable step is needed to create adaptive UoLs in IMSLD editors. However, the use of IMSLD as an inter-lingua for existing tools from the Adaptive Hypermedia arena seems a promising line of investigation.

Valerie Shute and Brendon Towle (2005)\textsuperscript{17} review some of the demonstrated effects of ATIs, describe how ATI research naturally leads to adaptive e-Learning, and describe one way in which an adaptive e-Learning system might be implemented to take advantage of these effects. It is usually and rightly esteemed an excellent thing in a teacher that he should be careful to mark diversity of gifts in those whose education he has undertaken and to know in what direction nature inclines each one most.

In view of the authors there are so many important reasons to pursue adaptive e-Learning. The potential payoffs of designing, developing and employing good e-Learning solutions are great and they include improved efficiency, effectiveness and enjoyment of the learning experience. In addition to these student-centered instructional purposes, there are other creative uses. Ideally, an assessment comprises an important event in the learning process, part of reflection and understanding of progress. In reality, assessments are used to determine placement, promotion, graduation or retention. The authors advocate pursuing the idea via online diagnostic assessments.

As Snow and Jones (2005)\textsuperscript{18} pointed out tests alone cannot enhance educational performance. Rather, the tests can guide ‘improvement presuming’ they are valid and reliable - if they motivate adjustments to the educational system. There are clear and important roles for good e-Learning programs. However, the state of e-Learning is often little more than online lectures, where educators create electronic versions of traditional printed student manuals,

\textsuperscript{17}Valerie Shute and Brendon Towle, “Adaptive E-Learning”, Educational Psychologist, 38,(2), pp.105-114,2005.

articles, tip sheets, and reference guides. Although these materials may be valuable and provide good resources, their conversion to the Web cannot be considered true teaching and learning.

There are a lot of companies attempting to provide adaptive e-Learning solutions. However, many of these are not concerned with adaptive instructions at all; rather, they are concerned with adapting the format of the content to meet the constraints of the delivery device, or adapting the interface to the content to meet the needs of disabled learners.

Of those that are concerned with adaptive instruction, most tend to base their adaptivity on assessments of emergent content knowledge or skill or adjustments of material based on learner styles less suitable criteria than cognitive abilities for making adaptive instructional decisions.

The authors hope that the time is suitable to develop e-Learning systems that can reliably deliver uniquely effective, efficient, and engaging learning experiences, created to meet the needs of the particular learner.

The required ingredients in such a personalised learning milieu include rich descriptions of content elements and learner information, along with robust, valid mappings between learner characteristics and appropriate content. The result is adaptive e-Learning, a natural extension of Snow’s considerable contributions to the field of educational psychology.
Stefan Dietze et al (2007)\textsuperscript{19}, indicate that the supporting e-Learning objectives is primarily based on providing a learner with learning content by using metadata standards like ADL SCORM 2004 or IMS Learning Design. By following the approach, several issues can be observed – e. g. high development costs due to a limited reusability across different standards and learning contexts. To overcome these issues, the approach changes this data centric paradigm to a highly dynamic service-oriented approach. By following this approach, learning objectives are supported based on an automatic allocation of services instead of a manual composition of learning data. The approach is fundamentally based on current Semantic Web Service (SWS) technology and considers mappings between different learning metadata standards as well as ontological concepts for e-Learning. Since the approach is based on a dynamic selection and invocation of SWS appropriate to achieve a given learning objective within a specific learning context, it enables the dynamic adaptation to specific learning needs as well as a high level of reusability across different learning contexts.

The approach of the authors - the support of learning objectives based on a dynamic invocation of SWS at runtime of a learning process model follows an innovative approach and is distinctive to the state of the art in this area. Due to a dynamic towards adaptive E-Learning Applications based on Semantic Web Services allocation of most appropriate resources – data and services – a wide variety of distributed learning resource repositories can be integrated.

Since the framework is developed only in parts currently, next steps have to be concerned with the implementation of complete ontological representations of the introduced semantic layers as well as of current e-Learning metadata standards and their mappings. Nevertheless, the availability of appropriate Web services aimed at supporting specific process objectives has to be perceived as an important prerequisite for developing SWS-based applications. Besides that, future work could also be concerned with the mapping of semantic process models across different process dimensions - e.g. business processes or learning processes to enable a complete integration of a SWSOA in an organisational process environment.

**Vitalis Ndume et al (2008)**\(^{20}\) have made a research with the purpose of establishing the acceptance of e-Learning, analyses the challenges of e-learning and designs an assistive tool for people with disability at higher learning institutions in Tanzania. The information was gathered through documentary review. Primary data was collected from a sample survey by means of structured questionnaires and interviews. Study population was carried out at higher learning institutions conducting e-Learning. The research identified several factors that challenge the implementation of adaptive e-Learning at higher learning institutions. These include management support, methodology, technology, resource accessibility and availability, culture of education and learning styles, design of assistive tools, intellectual investment and global business.

Research instruments were designed and categorised by the authors into two parts. Part one was designed to measure people’s perception on a

phenomenon and identifies factors that challenge e-Learning. This could be done into two major categories, namely direct assessment or indirect assessment.

In order to identify principal component factors, which challenge e-Learning, new variables were computed by summing up all items in each group? For each group, data reduction by factor analysis was carried out in order to extract principal components. A rotated component matrix was identified by using varimax with Kasiser Normalisation. Some rotated convergences were found after 8 iterations and others after 5 iterations. In a component, percentage of variance ranged from 45% to 0.9%. In order to identify contribution of each item, correlation analysis was carried out. The correlation factors ranged from 0.87 to 0.45 and it was significant at 0.05.

The survey found out that the people’s perception of e-Learning is greater at the tertiary level of education than at the basic education. However, there are still doubts about the certificate obtained from online programs. Concerning factors challenging implementation of e-Learning, several factors were identified and found to be interrelated in affecting e-Learning. It is important to note that, before commencing an e-Learning program, capacity analysis needs to be done first. It was found that the learning culture is also one of the obstacles in adapting e-Learning. Therefore, implementers must be careful and sensitive in how to promote e-Learning as a phenomenon for development. However, it is not easy to please everybody’s feelings concerning e-Learning, and so it is important for the government to take action to implement e-Learning as long as the majority accepts it. The analysis of the technology, resource accessibility and availability revealed that there is an existing initiative by the government, private companies, and NGOs to improve IT infrastructure. Even though power interruption is a problem for implementing e-Learning, people still can get other means of power sources
such as using generators or solar energy. It was observed that the reduction of
taxes on computer items has enabled some people to afford their own personal
computers or laptops. Regarding the global market and intellectual investment,
it was found that in order for e-Learning courses to produce an outcome that is
competitive in the global employment market, Universities need to invest
carefully in online courses.

According to Maryam Yarandi et al (2008)\textsuperscript{21} the significance of
personalization towards learners’ needs has recently been agreed by all web
based instructional researchers. This study presents a novel ontology semantic
based approach to design an e-Learning Decision Support System (DSS) which
includes major adaptive features. The ontologically modeled learner, learning
domain and content are separately designed to support personalised adaptive
learning. The proposed system utilise captured learners’ models during the
registration phase to determine learners’ characteristics. The system also tracks
learner’s activities and tests during the learning process. Test results are
analysed according to the Item Response Theory in order to calculate learner’s
abilities. The learner model is updated based on the results of test and learner’s
abilities for use in the adaptation process. Updated learner models are used to
generate different learning paths for individual learners. In the study, the
proposed system is implemented on the “Fraction topic” of the mathematics
domain. Experimental test results indicated that the proposed system improved
learning effectiveness and learner’s satisfaction, particularly in its adaptive
capabilities.

Adaptation and personalization services of the information offered to the users in open e-Learning environments are considered to be the turning point of recent research efforts. The “one-size-fits-all” approach has some important drawbacks, from the educational point of view. Adaptive Educational Hypermedia Systems in World Wide Web became a very active research field and the need of standardisation arose, as the continually augmenting research efforts lacked the interoperability dimension. In this way, Sotirios Botsios and Dimitrios Georgiou (2008)\(^{22}\) classifies up to date research work indicating some important points that can lead to an open and unified architecture that support an Adaptive e-Learning System based on widely accepted standards.

There exists a wide variety of diverse Adaptive and Intelligent Web Based Educational Systems. The ‘rules’ that are used to describe the creation of such systems are not yet fully standardised and the criteria that need to be used pedagogically effective rule-sets (i.e. adaptation parameters) are poorly mentioned. With the paper the authors provide a starting point for the development of a unified architecture for the retrieval of LOs from disperses LOR to an e-Learning environment. This LO “journey” must comply with widely accepted standards.

The model is based on a distributed architecture. Inter-operability, information sharing, scalability and dynamic integration of heterogeneous expert fields are considered as the major advantages of the proposed model. a. Interoperability: support for available standards, technology and platform independent. b. Information Sharing: user information, learning objects, 

services and assessment tools. c. Scalability: continuous update of each module’s functionality (Learning Objects, monitoring tools, cognition and learning style theories, sequencing and navigation algorithms). d. Integration of heterogeneous expert field: independent module development and dynamic adaptation to the latest criteria.

Edmond Holohan et al (2008)\(^{23}\) in their paper concentrate mainly on conceptual learning. The Semantic Web has triggered some new developments in knowledge engineering and machine learning, most notably the standardisation of knowledge specifications. Standardised ontologies already serve as shared conceptual-knowledge skeletons, and declarative knowledge processing specifications may soon be used to model tasks requiring common problem-solving skills such as procedure selection and application. The project represents some steps in this direction. Specifically, the authors propose to semi automate the generation of courseware learning objects by applying graph transformations to the concept graphs represented by the ontologies of the Semantic Web.

The research paper reflects the functional architecture of the system. Firstly, they position their work in the broader context of current of Artificial Intelligence in Education (AIED) research. Then they describe the basic functionality of the system, the generation and export of static courseware. By this they mean the production and export of stand-alone standard learning objects such as slide sequences or tests. Next, they discuss extensions to this functionality in the generation of courseware for flexible delivery. By flexible

delivery here they mean run-time support for combinations of the various forms of navigation and adaptivity. The authors evaluate our experiences to date and we briefly discuss the possibility of semi-automating also the generation of learning objects that can exercise a learner’s problem solving skills.

The advent of the Semantic Web shows great promise for education and knowledge management generally. However, in addition to the benefits accruing from the normal uses of this new environment, the Semantic Web vision can already be exploited in support of courseware engineering.

The authors are generalising on this by allowing the teacher to specify in advance the sequencing algorithms and broader instructional strategies to be employed. According to the view of authors, future work will examine whether Semantic Web technology can be used to semi-automate the production of such advanced dynamic LOs. Semantic-Web technology consists, not merely of the static source ontologies themselves but also of the tools used to reason with and transform these ontologies.

Alexandros Paramythis and Susanne Loidl-Reisinger (2008)\textsuperscript{24} examined the sufficiency of existing e-Learning standards for facilitating and supporting the introduction of adaptive techniques in computer-based learning systems. To that end, the main representational and operational requirements of adaptive learning environments are examined and contrasted against current e-Learning standards. The motivation behind this preliminary analysis is attainment of: interoperability between adaptive learning systems; reuse of

adaptive learning materials; and, the facilitation of adaptively supported, distributed learning activities. This research work has attempted a preliminary assessment of the adequacy of existing e-Learning standards for supporting the introduction of adaptation techniques in e-Learning systems. The analysis, however cursory due to space limitations, has pointed out that existing standards do have some provisions for adaptation, but require substantial extensions to accommodate common practice in ALEs.

The authors argued that such extensions should happen in a way that keeps the “entry cost” of employing adaptation facilities in the development of e-Learning materials, as to low levels as possible (mainly in terms of invested resources).

The adoption of the new standards or extensions proposed in the research paper is highly dependent upon the development of authoring tools that facilitate the creation of compliant resources. The creation of high quality standards compliant- learning material is already a quite demanding goal. The introduction of adaptation facilities will inevitably impose an additional “burden” on content creators. In order to bring the related cost / benefit ratio to non-prohibitive levels, it is necessary to have tools that: can assist authors in converting “static” material; support the authoring of adaptive content; enable the specification of adaptively supported activities in ALEs; etc.

Finally, a factor that will influence the adoption of such standards is the availability of software components that can support different aspects of the adaptation process at run-time (a typical example being user / student modeling components). The Knowledge Tree framework (Brusilovsky and Nijhaven,
2009)\textsuperscript{25} represents an integrative effort in this direction. The latter is intended to facilitate interoperation and reuse at the level of distributed, reusable learning activities (with the emphasis being on learning activities, as opposed to learning objects). Specifically, Knowledge Tree goes into the realm of run-time communication and interoperation standards, seeking to standardise the ways in which different specialized subsystems supporting aspects of the (adaptive) learning process can communicate and exchange information that would allow them to be aggregated into a whole. The evolution of such efforts will hopefully bring about a generation of ‘off the shelf’ components that can be easily integrated into an ALE.

In view of Christopher Watson \textit{et al} (2009)\textsuperscript{26} due to the differences in background knowledge, learning styles and preferences, individual students may take very different approaches towards learning. In light of this, adaptive educational hypermedia systems (AEHSs) have been developed by Christopher Watson \textit{et al} to offer students personalised learning content to improve their learning outcome. These systems typically use programming scripts and hierarchical course structures as primary techniques to support adaptive e-Learning course authoring for different types of students. They require teachers not only to have substantial technical skills, but also to be able to implement theories of learning styles, which are tough requirements. The authors have


implemented the proposed interfacing mechanism in an online adaptive e-Learning system and conducted user studies to evaluate its effectiveness.

The authors present a novel methodological interface in their paper to support adaptive e-Learning course authoring. This interface provides a graphical illustration on the pedagogical meanings of different course settings, which can both enhance the teacher’s understanding on adaptive e-Learning and can turn adaptive e-Learning authoring into a graph manipulation process, which is easy and intuitive.

They have implemented a workable system and have conducted a workshop with some teachers in a local special needs school to study the usability of our system and have collected their opinions between using our system and two reputable existing systems. Results show that pedagogical interface is a favorable solution for supporting adaptive e-Learning course authoring, particularly emphasizing its understandability and learnability.

According to a survey conducted by Mark Melia and Claus Pahl (2009)\(^\text{27}\) the personalised e-Learning allows the course creator to create courseware that dynamically adapts to the needs of individual learners or learner groupings. This dynamic nature of adaptive courseware makes it difficult to evaluate what the delivery time courseware will be for the learner. The course creator may attempt to validate adaptive courseware through dummy runs, but cannot eliminate the risk of pedagogical problems due to adaptive courseware’s inherent variability. Courseware validation checks whether adaptive courseware conforms to a set of pedagogical and non-

pedagogical requirements. The validation of adaptive courseware limits the risk of pedagogical problems at delivery time.

In the research paper, the authors present the approach to adaptive courseware validation using the Courseware Authoring Validation Information Architecture (CAVIAr). The authors outline how CAVIAr captures adaptive courseware authoring concerns and validates courseware using a constraint-based approach. They also describe how CAVIAr can be integrated with the state of the art in adaptive e-Learning and evaluate our validation approach. The authors have defined CAVIAr, a formal modeling framework used to express courseware in terms of its design and its requirements. The authors illustrated how valid courseware can be defined in terms of CAVIAr constraints using OCL. Constraint-based validation of courseware is a novel approach to courseware validation, where constraints are defined on courseware modeling constructs. This differs to the state of the art in validation, where validation is based on a simulation of learner progression through every possible learning path in a given courseware. This can lead to computational problems where there are many learning paths through courseware.

The approach is better suited to personalised courseware as it is not adversely affected by many learning paths. Because the approach validates courseware in terms of its compositional structure rather than the possible learning paths it represents. The evaluation of constraint-based validation shows that course creators are more confident that adaptive courseware has been constructed correctly after validating it using CAVIAr. Validation reduces the risk of delivering pedagogically unsound courseware to a learner due to errors in personalization definitions.

According to the authors, the CAVIA constraints are represented in OCL, a language designed for software engineers, not course creators. They
have outlined our work, creating a simple model-based user interface for creating validation constraints. And the authors are also investigating the reuse of annotated instructional constraints. This way, the course creator does not, in general, have to define constraints but just looks for them in a constraint repository. A further extension to this would allow the grouping of instructional constraints into instructional designs, allowing the course creator to work at an even higher level of abstraction. They would like to genarlise the validation approach to consider other e-Learning opportunities, such as (semi-)automatically generated courseware for self-learning. They would also like to consider the dimension m-learning would present to CAVIAR, such as considering the device the learner uses at delivery time.

Luisa dall’ Acqua (2009)

explain that the Learning Management Systems are able to support online training with different levels of granularity and formalisation. The focus is on automation of some aspects of the design process, execution and assessment to interpret and manage the reticular nature of knowledge. The contribution of the author proposes a multidimensional design model that describes the specifications needed for an educational environment, able to: increase productivity and operability, create conditions for a cooperative dialogue, and develop participatory research activities of knowledge, observations and discoveries (ecological learning environment), and customise the learning design in a complex and holistic vision of the learning / teaching process. In particular, the authors examined the conditions that make a learning environment “adaptive”, and how those conditions are realised in an e-Learning system.

Finally the author concludes that the concept of personalization is fundamental for the innovation process in e-Learning. So, the author suggests an instructional design model (PENTHA Model) which recognises five conceptual dimensions, and describes didactical strategies, tutoring modes and learning dynamics for learning path adaptation on intelligent LMS platforms. The author summarises what functions must be present and supported by the LMS platform to realise/optimise the Learning Design for an “Adaptation approach”. The functions offered by the available LMS’s or similar software products partially satisfy the requirements. Some of the issues may still remain open for further research. To achieve an LMS based “Adaptive Learning Environment” the characteristics mentioned by the author should be present in an adequate form to support.

Vatcharaporn Esichaikul et al (2010)\(^{29}\) point out that the e-Learning systems provide web-based learning so that students can access the same online courses via the Internet without adaptation, based on each student's profile and behavior. In an e-Learning system, one size does not fit all. Therefore, it is a challenge to make e-Learning systems that are suitably adaptive. The aim of adaptive e-Learning is to provide the students the appropriate content at the right time, means that the system is able to determine the knowledge level, keep track of usage, and arrange content automatically for each student for the best learning result. The study made by the authors presents a proposed system which includes major adaptive features based on a student model. The proposed system is able to initialise the student model for determining the knowledge level of a student when the student registers for the course. After a student starts

learning the lessons and doing many activities, the system can track information of the student until he/she takes a test. The student’s knowledge level, based on the test scores, is updated into the system for use in the adaptation process, which combines the student model with the domain model in order to deliver suitable course contents to the students. In this study, the proposed adaptive e-Learning system is implemented on an “Introduction to Java Programming Language” course, using Learn Square software. After the system was tested, the results showed positive feedback towards the proposed system, especially in its adaptive capability.

At the conclusion, the authors indicate that an adaptive system is based on three principal models: a domain model (which is all about domain content for teaching), a student model (which collects all necessary student information), and an adaptation model (which is used in adaptation by combining both a domain model and a student model).

For student modeling, the Dempster-Shafer theory is applied to initialise and update data on the student knowledge level collected in the student model. An important aspect of this theory is its capability to manage uncertainty in scoring the student’s test. It is highly accurate at determining the student knowledge level. For adaptive hypermedia, the proposed system is developed by using all techniques from adaptive navigation support, which are direct guidance, link sorting, link hiding, and link annotation.

The proposed system can recommend and sort all section links that are suitable for the student’s current knowledge level. Furthermore, it can annotate the section knowledge level with colored balls to represent various grades.
Peter Brusilovsky (2010)\textsuperscript{30} presents Knowledge Tree, architecture for adaptive e-Learning based on distributed reusable intelligent learning activities. The goal of Knowledge Tree is to bridge the gap between the currently popular approach to Web-based education, which is centered on learning management systems vs. the powerful but underused technologies in intelligent tutoring and adaptive hypermedia. This integrative architecture aims to address both the component-based assembly of adaptive systems and teacher-level reusability.

Knowledge Tree is a distributed architecture for adaptive E learning based on the reuse of intelligent educational activities. Capitalising on the success of integrated LMS, Knowledge Tree aims to provide one stop comprehensive support for the needs of teachers and students who are using the e-Learning. It doing so it attempts to replace the current monolithic LMS with a community of distributed communicating servers (or services). The architecture assumes the presence of at least four kinds of servers: activity servers, value-adding services, learning portals, and student model servers. These kinds of servers represent the interests of three main stakeholders in the modern e-Learning process: content and service providers, course providers, and students. A learning portal represents the needs of course providers, teachers (trainers) and their respective universities (or corporate training companies). A portal plays a role similar to modern LMS in two aspects.

The paper of Peter Brusilovsky (2011)\textsuperscript{31} proposes an architecture for adaptive e-Learning based on distributed reusable intelligent learning activities


that integrate the benefits provided by modern LMS and educational material repositories with the power of ITS and AH technologies.

This architecture addresses both the component based development of adaptive systems and the teacher-level reusability. It is started by implementing the core functionality of the system within our local group by using some rather simple approaches to implement the required protocols. Some other groups driven by similar goals have proposed other architectures that match vision. A significant amount of work and cooperation between several research groups will be required to turn the proposed architectures into the common practice of e-Learning.

**Daniel Burgos and Marcus Specht (2011)**\(^{32}\) show in their research article how several classical methods in adaptive learning can be addressed using IMS Learning Design. After a definition of four main questions to classify adaptive educational methods we describe a group of features in the Levels B and C of the specification that make possible diverse types of adaptation.

According to the authors, IMS LD consists of three levels. Each level itself provides specific features to the educational information pack, called Unit of Learning. Furthermore, Level A provides method, plays, acts, roles, role-parts, learning activities, support activities and environments; Level B provides properties, conditions, calculations, monitoring services and global elements;

and Level C provides notifications. Every level is built on the previous one. Besides, the basic and crucial structure provided by Level A, the elements of Levels B and C become the actual key for adaptation, as they combine properties with conditions and other features that encourage and make more flexible the content and the learning flow.

The author finds out that the IMS LD enables a standardised way for designing personalised learning experiences. The combination of Properties, Conditions, Global Elements, Calculations and Monitoring services allows modeling a variety of classical adaptive methods mainly based on environment, content, user groups and learning flow, such as reuse of pedagogical patterns, adaptability, navigational guidance, collaborative learning, contextualised and mobile distributed learning, adaptation to stereotypes. The forthcoming research on Level B and Level C aims to provide new expressive ways of modeling traditional adaptive e-Learning.

Rodica Potolea et al (2012)\textsuperscript{33} mention that the adaptive e-Learning systems represent a new paradigm in modern learning approaches. They are not only targeting curricula segmentation, as providing large quantities of content is not the ultimate goal, but focus on the quality of knowledge transfer. In doing so, the correct identification of the user learning style in order to provide the appropriate content presentation to each individual user is essential. Moreover, a continuous reevaluation and classification is important to cope with the progress made during the learning process, and to ensure the evolution to a better style. Concept maps represent useful instruments in both developing quality high structured content and automated evaluation. The research article

presents a model for an adaptive e-Learning system, and details the modules responsible for the user type identification and concept maps.

The authors have presented their view on the adaptive e-Learning strategy. They have designed, implemented and evaluated the model of an e-Learning system, containing elements from the aptitude treatment strategy. The most challenging task is represented by the intelligent module – the component that identifies the user's type. Solution of the authors consists of a layered approach: a clustering layer, for the initial assessment, based on the fixed factors (user's static features). The second layer consists of a SOM that receives both static and dynamic features. As the users’ interaction with the system intensifies, the structure of the SOM changes accordingly, indicating the current user type. The experiments on synthetic data have shown a correct identification of the four learning strategies mentioned in the literature. Moreover, they indicate an even better separation of the clusters by the evaluation of both static and dynamic features. This is a welcome validation of their assumption that dynamic attributes are better indicators of the evolution on the user learning style.

**Cord Hockemeyer and Dietrich Albert (2012)**\(^{34}\) point out that one important aim of LeGE-WG is the integration of new e-Learning methodologies into Learning Grid technology. A central issue in these new e-Learning methodologies is the concept of individualised and personalised learning to be realised by adaptive tutoring systems. The adaptivity of such systems goes far beyond adapting to the users’ preferences with respect to the user interface; in

---

cooperation between computer science, psychology, and pedagogy, systems adapting, e.g., to the individual learners’ current knowledge, cultural background, learning style, or special needs are developed. Adaptive tutoring systems can be integrated into a Learning Grid at different levels of ambitiousness. The authors discuss these different levels of integration based on the prior experiences with respect to reusability of adaptive learning resources.

The developments described in the research provide already a large step for the integration of adaptive material and adaptive services into a Learning Grid. However, the integration can be performed at different levels. At a minimal level, the Grid provides only user authentication while all other functionality is kept within an independent adaptive server. In a second step toward higher integration, also other information about the learner are stored within the Grid and are thus exchanged between different adaptive servers belonging to the same Grid.

While in the aforementioned levels adaptivity is basically still provided through a self-contained adaptive server, the third level of integration starts realizing adaptivity in a distributed service through content repositories distributed over the Grid while the core adaptive system is still located at one server. Finally, adaptivity itself could be realised in a distributed way through co-operation of different adaptive servers and services over the Grid. Methods for such distributed adaptive services have yet to be developed. However, integrating adaptivity into Learning Grid technology at such a high level promises to bring forward also a higher level of adaptivity than it could be realised on stand-alone services. 1st LEGE-WG international workshop on e-Learning and GRID Technologies: Educational models for GRID based services
Christian Gutl (2012)\textsuperscript{35} strongly points out that due to the rapidly growing amount of knowledge, a stronger need emerges for efficient and improved knowledge acquisition strategies. The e-Learning can be very helpful for different learning activities in various learning environments. However, in order to support different teaching and learning paradigms, e-Learning should deal with more than simply reading online lessons. Therefore, content as well as communication and collaboration have to be supported in a highly personalised manner by e-Learning systems. Though, tracking and grasping the user behaviour in real time remains the most challenging task to retrieve an appropriate and fine-grained user profile as well as to provide personalised learning content. In this paper the authors present AdeLE, a technology-based solution of an enhanced adaptive e-Learning framework, which comprises novel solution approaches for fine-grained user profiles by exploiting real time eye-tracking and content-tracking analysis as well as a dynamic background library. Based on the global objectives of an enhanced e-Learning environment, the system architecture of AdeLE and the methods used in order to gain fine grained user information by real time eye-tracking are addressed. Furthermore, various scenarios in different application domains are illustrated in his research work.

Evidently, the price of an advanced eye-tracking system plays a decisive role in the application possibilities of the AdeLE solution approach. Nevertheless, existing systems show that an eye-tracking device can be integrated into a standard monitor. Due to the continuing trend of rapid

technical progress, it may be expected that in the next few years it would be possible to build a low-cost but high-quality eye-tracking system based on standard hardware components, which would be suitable for real-time analysis of eye-tracking information as described in this paper. Some results of the AdeLE project may contribute to find new ways of making advanced adaptive environments for teaching and learning feasible and affordable for institutions in a relative near future.

According to Symeon Retalis (2012) the use of digital games in education is well documented in the literature. Adding board games to the educational process can lead to an interactive stimulating learning experience. With a board game, players often learn from one another while at the same time having fun in a competitive environment.

In this paper the authors propose the "ELG" game, an e-Learning board game that adopts the basic elements of a racing board game but fosters students’ creativity, problem-solving skills, and imagination as students are trying to reach the end by improving their performance in a variety of learning activities. The innovative feature of the ELG is that it offers an adaptive authoring tool that enables teachers to customise their games according to the needs, interests and motives of students. The teacher enters hierarchically categorised learning activities according to the learning goals of a course, sets the rules and assesses the learning progress easily and simply. Students participate in a discovery or exploration trying to reach the goals. After attaining them, their level of activities is upgraded and they are challenged to

reach the next learning goal. The dice in ELG is not randomised but controlled by the teachers in order that they can customise adaptive learning rules. The educational benefits of exploiting ELG in the learning process is that the teacher can define the levels of difficulty according to the students’ needs and interests, facilitate and monitor the learning rate of each student, combine a variety of evaluation techniques, and address potential learning problems in a timely manner.

Zhixian Yan and Yanyan Li (2012)\textsuperscript{37} observed that the Knowledge Grid is a platform that enables uniform and effective knowledge sharing and management across the Internet. Based on it, this paper proposes an adaptive e-Learning in China Knowledge Grid environment (CKG-AL for short), which supports the learner-centered, highly interactive and on-demand e-Learning with dynamic courseware construction. By incorporating ontology-based metadata for knowledge representation, learning objects for courseware construction and semantic link network for knowledge interconnection AeL can separate learning materials from its contents, which would in turn improve the efficiency and effectiveness for constructing and reusing courseware, and provides the basis for adaptive learning. By absorbing the ontology and intelligent agent technologies, CKG-AL constructs four level Knowledge Nets to support adaptive e-Learning, namely, KGDomain Knowledge Net, KG Course Knowledge Net, KG Tutor Knowledge Net etc.

Greg Gay (2012)\textsuperscript{38} conducted a survey in the University of Toronto’s Adaptive Technology Resource Centre (ATRC) a technical audit and user study


that examined the support being provided by popular online learning management systems for students with disabilities. Both studies revealed that none of the current systems was inclusive to all potential learners. What evolved out of the results of these studies was the A Tutor Learning Content Management System, which was developed with the guiding philosophy of accessibility and adaptability for all. The development team’s initial focus was to develop a system that was accessible to all potential users regardless of the technologies they might be using to browse the Web. Lastly, the author focused on making the system highly customizable, so groups using A Tutor could easily modify the look and feel of the learning environment. A Tutor continues to evolve and expand. Many related secondary projects are underway to extend its functionality and its community of users is rapidly growing.

In view of Zuzana Melicherikova, Alena Busikova (2012)\textsuperscript{39} in spite of increased use of information and communication technologies in many areas, e-Learning is not widely used by Slovak universities as it is still considered as an inferior way of education. In the article they deal with the advantages and disadvantages of e-Learning. The authors concentrate on adaptive e-Learning as a tool to overcome the disadvantages. On the practical experience of School of Management they present how adaptive e-Learning might be applied in the area of higher education.

From the review of literature, it is clear that the previous researches on the AeL have been undertaken on the experimental designs and they have taken the same type of methodology. Major concentration on the past studies were on

content based issues, presentation of the contents, thematic dimensions, knowledge packed subjects and operational strategy of the AeL. Technology oriented issues were taken into consideration and the implementation strategy was discussed as the major problem. Less concentration was paid on the personality traits in respect of the learning procedure. But, no concentration has been paid on the Medium of Instruction of the students towards the knowledge level. So, the present research takes this issue as a major core of the research content. The methodology of the research has been adapted from the previous researches but, usage of it depends upon Indian educational environment.