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Objectives and Content of E-module
"Tools for Adaptive Learning. Learning Styles"
within the MOOC Course "ICT Tools for E-learning"

Abstract

The paper presents the objectives and content of the educational module "Tools for Adaptive Learning. Learning Styles" within the MOOC course "ICT Tools for E-learning," which is being developed at the University of Ostrava as an outcome of the IRNet project. The main aim of the course is to provide both academic scholars and students with the theoretical foundation of adaptive learning that will allow them to acquire skills, to use the existing courses in the existing adaptive e-systems, and/or to create new courses and systems. The content of the course includes the following: defining basic constructs used in the course; overview of the development of adaptive learning with the use of educational technologies, its theoretical concepts, and representatives; presentation of the results of the previous researches and educational effects of adaptive (e-)learning, and some of the concepts of adaptive learning that have recently been developed at the University of Ostrava.

K e y w o r d s : MOOC course, adaptive learning, adaptive instruction, learning styles, adaptive learning tools, adaptive learning systems, intelligent adaptive learning, adaptive educational hypermedia systems, adaptive e-learning

Introduction

As a result of the development of ICT, adaptive instruction which takes learners' unique pre-requisites and needs into account is constantly being modified and updated. One of the main pre-requisites of learners is their learning style, which can be categorised according to a number of criteria based on cognitive and emotional aspects of personality. The combination of those learning styles in each individual leads to countless real ways of learning, which can be – to a certain degree – affected by the current e-learning resources. Those e-learning resources that have predefined features, which allow them to adapt to the learners' entry characteristics during instruction management or to react to their current results, are adaptive e-learning systems (AES) and/or intelligent AES.

That is why a team at the University of Ostrava has been developing the module "Tools for Adaptive Learning. Learning Styles" within the MOOC course "ICT Tools for E-learning," which should teach the operators and creators of AES and AAS as well as teachers at all school levels, including university teachers and teachers of adults, how to effectively use and implement them. Moreover, the course should provide them with conceptual knowledge, the information about the development and direction of adaptive learning, adaptive e-learning tools, information about the results of their implementation, and skills needed to use them for evaluation.

Methodological Bases

In the late 1950s, the idea of instruction using educational machines was introduced by Gordon Pask. He thought such instruction could be based on the conversation and game theories. Therefore, he created adaptive educational programmes.

A revival, which has resulted from the updates in the ICT area, followed the era in which there was little interest in the ideas of adaptive learning, the main reason of which was the overall state of the movements that promoted and realised different concepts of personalised learning. The revival has also been sparked by knowledge development in the area of cognitive styles, learning habits, approaches to study, learning modes, and learning styles.

Aimed at individualisation and, to a certain degree, personalisation of learning, the so-called Intelligent Adaptive Learning (IAL) has been on the rise since the beginning of the 21st century. It is defined as digital learning which is based on students working in modular learning environments where every decision they

make is captured and considered within the sound learning theory. Those decisions are then used to guide their learning experiences, to adjust their path and pace within and between classes, and also to provide their teachers with formative and summative data. Tailoring instruction to each student's unique needs, current knowledge and interests, this type of instruction ensures that all responses are in compliance with sound pedagogy. The IAL system is designed to: a) be the student's personal tutor, b) individualise the learning pace, c) regulate the student's cognitive load, d) adapt the sequence of the curriculum and associated learning experiences, e) engage students in learning through games (Dreambox, 2011). Dreambox, an adaptive programme which is being developed in the USA and Great Britain, has shown promising results (WWC Intervention Report, 2013; Harvard University, 2016).

Aimed at the development of adaptive learning in the university environment (see the aforementioned definition), the Tyton Partners paper (2016) introduces interesting facts concerning the evaluation of current e-learning products. Moreover, it presents the reasons why the approach of universities to instruction needs to be changed, thus providing reasons for the implementation of the products. As a result, instruction will become:

1. Active – technology is used to add focus to the faculty's role as instructors who shape not only the "journey," but also the learning outcomes;
2. Relational – the faculty works as subject matter experts, coaches, and guides alongside students as they are making progress through an adaptive curriculum or assessment;
3. Involved – the faculty uses digital features and functions that enable it to guide students through a course, programme, or module, and to stage interventions and interactions as needed;
4. Insightful at scale – the faculty uses learning maps, dashboards and analytics to make the student's progress more transparent; it also uses flags or indicators to suggest potential interventions that may help the student be successful.

Moreover, the paper also provides recommendations for new users of adaptive systems and introduces 20 systems (platforms).

The annual IMS Global Learning Consortium reports are the basis for numerous impulses that encourage universities and academics to use the adaptive learning and teaching systems. The 2013 report contains a two-dimensional matrix (Implementation Challenges and Learning Impact Gain/Potential), in which online homework, adaptive learning, and formative assessment were placed 3rd. As the authors assess adaptive learning as "Clearly superior," "Straightforward/Turnkey," it is clear that they see great potential in it.

The 2015 report (IMS Global, 2016) introduces the following three new Learning Impact Trend categories, all of which contain elements of personalised learning: a) Integrated Digital Curriculum to Enable Student-centred Learning highlights new ways of managing digital content and alternative tools; b) Assess-

ment Enhancements with Digital Technology deals with the growing number of technology-based tools, and applications aimed at the assessment of student performance and learning outcomes; c) Educational Accessibility and Personalisation focuses on the increasing ability of technology to enhance learning experiences of all students, including those with physical and learning disabilities.

The results of conducted experiments are the basis for determining the trends in implementing ICT into education, i.e. the adaptive e-learning development.

Even though Beckman, Bertel, and Zander (2015) have not found the impact that instruction adapted to students' preferred learning styles has on the verbal and visual areas to be statistically important, they have learned that such instruction influences emotional factors such as satisfaction and motivation. Since emotional factors play a key role in self-regulated learning, their importance should not be downplayed.

Surjono (2015) focuses on the effects of instruction which takes place in an adaptive system, which is able to realise instruction based on the student's learning style and preferred multimedia. He has named the adaptive system the "learning mode." He has found out that on three successive occasions, the results of students who used a particular learning mode were better than the results of students who used the system in which "their" mode was not available.

In concluding their study aimed at comparing adaptive and traditional instructions, Murray and Pérez state that "adaptive learning is touted as a potential game-changer in higher education, a panacea with which institutions may solve the riddle of the iron triangle: quality, cost, and access. Though the research is scant, this study and a few others like it indicate that today's adaptive learning systems have negligible impact on learning outcomes, one aspect of quality. There is also evidence that adaptive systems positively impact other aspects of quality such as student persistence and engagement" (Murray & Pérez, 2015).

Target Group and Course Objectives

The target group will be internally differentiated and inhomogeneous. It will contain 4 sub-groups different in educational attainment and the degree of the expected involvement in the process of implementation of adaptive e-learning. The first sub-group will consist of the students from all three stages of the Informational and Educational Technologies study programme, studying either at the University of Ostrava or at one of its partner universities. Those should be actively involved in promoting, realising, and updating the course. The second sub-group will consist of volunteers studying one of the teaching study programmes, who are expected to use the systems in their university studies, but also to draw on their

experience with e-learning in the future when teaching children and/or adults. The third sub-group will consist of academic scholars interested in using the existing adaptive courses or creating new ones. Among them will be those who could specialise in developing new processes or systems of adaptive e-learning. The final group will consist of teachers who could use the course for their own development. They might then encourage their students to use this form of learning.

The course objectives should be set in three domains. In the cognitive domain, Anderson and Krathwohl's modified, two-dimensional taxonomy of educational objectives should be used. As far as knowledge is concerned, there are four dimensions: a) factual (knowledge of facts, terms, observations), b) conceptual (knowledge of classifications, patterns, theories, models, or structures), c) procedural (knowledge of specific algorithms, techniques, methods, and criteria of the appropriate procedure), d) meta-cognitive (general learning, problem-solving, task-identifying, and self-knowledge strategies).

As far as cognitive process dimension is concerned, the objectives are at the following levels: a) remembering, b) understanding, c) implementation, d) analyses, e) evaluation, f) creativity.

If the knowledge dimension is used as the basis for the presentation of the draft of the course objectives, the course participants will learn:

a) *Factual knowledge* and will be able to use it to realise particular cognitive processes:
 • names of the important figures and institutions focusing on adaptive learning,
 • names of companies and their products related to adaptive learning, and
 • titles of studies or academic papers,

b) *Conceptual knowledge:*
 • knowledge of definitions/basic terms;
 • knowledge of theoretical concepts of adaptivity in education, adaptive learning/e-learning, cognitive styles, learning styles, and approaches to learning;
 • knowledge of the results of particular researches or so-called good practice; and
 • knowledge of selected models of adaptive (e-)learning,

c) *Procedural knowledge:*
 • knowledge of the stages of the implementation of adaptive learning, including the evaluation stage and its effects;
 • knowledge of the main activities of the teacher/learner in adaptive learning;
 • knowledge of the processes realised by the selected adaptive e-learning systems; and
 • knowledge of limits, restrictions, and risks associated with the implementation of AES and AAS,

d) *Meta-cognitive knowledge:*
 • knowledge of information resources regarding AES/AAS-related products, and
 • knowledge of AES/AAS-related professional networks and communities.

In the *psychomotor domain*, the objectives will be aimed at the acquisition of the following skills:
- skills needed to be able to learn in the AES/AAS environment,
- skills needed to adapt to the changes in the AES/AAS technical and programme layout,
- teachers' skills needed to implement and encourage the use of AES/AAS in instruction,
- skills needed to reflect and evaluate particular processes and their outcomes,
- skills needed to use the evaluative (feedback) information for revision of learning processes and evaluation of students.
- In the *affective domain*, it will be the following objectives:
- convincing the course participants to accept the AES and AAS systems as effective and useful learning tools;
- a quick and appropriate reaction to scientific studies, "good practice" examples, and system updates;
- integration of AES, AAS, and other ICT components into the "personal educational tools and learning" folder and into the complex environment of an educational institution.

Content of Course Sub-modules

The one-term course consists of eight sub-modules. It is based on the chronological principle and on the from-theory-to-practice principle. Each sub-module has specific content, the understanding of which is tested at the end of the course through a distributed, formative, didactic multiple choice test. The results of the test can lead to the participant being advised to re-learn the sub-module curriculum, to pay more attention to the informational resources, and/or to consult the course tutor. At the end of the course, the participants need to take an exit (summative) test which they need to pass in order to receive a certificate of completion of the course.

Sub-module 1: Meaning and Conception of Adaptive Learning
Content:
- Definition of adaptive learning (AL),
- Basic terms,
- Meaning and potential of AL contemporary conceptions of education,
- Contribution of IAL (Intelligent Adaptive Learning) (Dreambox Learning),
- AL personalities (Pask),

- Selected AL conceptions (adaptation to the needs, performance, cognitive styles, learning styles, approaches to learning, types of intelligence, information perception techniques (through Eye tracking), etc.),
- Traditional vs. adaptive learning (Murray, Pérez).

Sources:

Murray, M. C., & Pérez, J. (2015). Informing and performing: A study comparing adaptive learning to traditional learning.

Leveraging intelligent adaptive learning to personalize education. (2011). Dreambox Learning.

Sub-module 2: Development of Theory and Practice of Adaptive Learning
Content:
- Outline of the AL development,
- Theoretical concepts of AL,
- Programmed learning (Skinner),
- Models of adaptive learning (Kostolányová),
- Adaptive learning research results,
- Current situation of adaptive learning at universities,
- Future of adaptive learning at universities (Tyton).

Sources:

Kostolányová, K. (2012). *The theory of adaptive e-learning*.

Learning to adapt. The evolution of adaptive learning in higher education. (2016). Tyton Partners.

Sub-module 3: Learning Styles, Cognitive Styles, and Approaches to Learning in Adaptive Learning
Content:
- Cognitive style (Mareš);
- Learning styles, definitions, classification of learning styles;
- Diagnostic tools for determining learning styles:
  - *Kolb's Learning Style Inventory (LSI)* by D. Kolb (1984),
  - *Inventory of Learning Styles (ILS)* by D.J. Vermunt,
  - *Learning Style Inventory (LSI)* by Dunn and Dunn,
  - *VARK Questionnaire (Visual, Autal, Read/Write, Kinesthetic)* by Fleming and Mills (1992),
  - *Thinking Style Inventory (TSI)* by Sternberg and Wagner (1999),
  - *Approaches and Study Skills Inventory (ASSIST)* by Entwistle (1996),
  - *Myers-Briggs Type Indicator (MBTI)* by Briggs and Briggs-Myers,
  - *Felder-Silverman Learning Style Model (FSLSM)* by Felder and Silverman (1988).

Sources:
Mareš, J. (1998). Pupils' learning styles.
Beckmann, J., Bertel, S., & Zander, S. (2014) Performance & emotion – A study on adaptive e-learning based on visual/verbal learning styles.

Sub-module 4: Adaptive E-learning and E-assessment and Their Theoretical Solutions
Content:
- Four evolutionary variants of adaptive e-learning: macro-adaptive approach, aptitude-treatment interaction approach, micro-adaptive approach, a constructi-vist-collaborative approach (Mödritscher);
- Adaptive e-learning systems (AES);
- Adaptive e-assessment systems (AAS);
- Effects of adaptive learning (Surjono);
- Three models of adaptive e-learning (content model, learner model, instruction model) (van Selers).

Sources:
Mödritscher, F., Garcia-Barrios, V. M., & Gütl, Ch. (2004). The past, present and the future of adaptive e-learning.
Surjono, H. D. (2015). The effects of multimedia and learning styles on student achievement in online electronics courses.
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Sub-module 5: Adaptive E-learning and E-assessment (AES and AAS) Tools
Content:
- UALS – User-centric Adaptive Learning System (Huang),
- AdeLE – Adaptive e-Learning with Eye tracking (University of Applied Science, Graz) (Mödritscher et al.),
- Adaptive learning management system based on Felder and Silverman's learning styles and mashup (Chang),
- AEHS – Adaptive Educational Hypermedia Systems (Somyürek).

Sources:
Huang, S. L., & Shiu, J. H. (2011). A User-centric Adaptive Learning System for e-learning.
Chang, Y. H., Chen, Y. Y., Chen N. S., Lu, Y. T., & Fang, R.J. (2015). Yet another adaptive learning management system based on Felder and Silverman's learning styles and mashup.
Somyürek, S. (2015). The new trends in Adaptive Educational Hypermedia Systems.

Sub-module 6: Development of Adaptive E-learning Systems
Content:
- Gagné's theory of learning elements (steps),
- ADDIE model as an approach to the creation of educational programmes (PHARE texts),
- AMDPC adaptive learning system (Adaptation with Multi-Dimensional Personalisation Criteria) (Yang).

Sources:
Yang, T. Ch., Hwang, G. J., & Yang, S. J. H. (2012). Development on an adaptive learning systems with multiple perspectives base on students' learning styles and cognitive styles.

Sub-module 7: Adaptive E-learning System at University of Ostrava
Content:
- A brief overview of the development of the interest of the Pedagogical Faculty of the University of Ostrava in the implementation and research of AES,
- Barborka LMS,
- Three-element model scheme,
- Student module,
- Author module,
- Expert module (Virtual Teacher).

Sources:
Kostolányová, K. (2012). *The theory of adaptive e-learning*.
Czeczotková, B., & Prextová, T. (2014). Creation of study materials for adaptive learning.

Sub-module 8: Adaptive E-learning System at Partner University (IRNet Project) where Course Takes Place:
Content:
- Type of installed AES,
- AES components (modules, tasks),
- Use of AES in regular instruction,
- Research/description of the effects of learning in AES.

Sources:
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Conclusion

The preparation of the syllabus of the study module and its transformation into online study materials – which will include short thematic video sequences, control tests, and the final test – requires its authors to have deep knowledge of the fundamental pedagogical and technological aspects of adaptive e-learning.

The paper describes the authors' effort to present the issue of adaptive e-learning to the students of the module from a variety of viewpoints, particularly from the psychological, pedagogical, and technological ones. The audio-visual presentation of the curriculum, the use of feedback, and the presentation of the content in an interesting manner – which will be achieved through the use of historical and comparative information, and the author's own experience with designing and using adaptive e-learning systems used at the University of Ostrava – seem to be potentially suitable didactic tools for the practical implementation of the course.

Acknowledgments

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Cele i zawartość e-modułu „Narzędzia do adaptacyjnego kształcenia. Style kształcenia" w ramach kursu MOOC „Narzędzia teleinformatyczne dla e-learningu"

S t r e s z c z e n i e

Praca przedstawia cele i zawartość modułu edukacyjnego „Narzędzia do adaptacyjnego kształcenia. Style kształcenia" w ramach kursu MOOC „Narzędzia teleinformatyczne dla e-learningu", który jest opracowywany na Uniwersytecie Ostrawskim jako wynik projektu IRNet. Głównym celem kursu jest zapewnienie zarówno pracownikom akademickim, jak i studentom teoretycznych fundamentów kształcenia adaptacyjnego, które pozwoli im przyswoić umiejętności, korzystać z istniejących kursów w adaptacyjnych e-systemach i/lub tworzyć nowe kursy oraz systemy. Kurs zawiera następujące elementy: definicję podstawowych konstrukcji użytych w kursie; omówienie rozwoju adaptacyjnego kształcenia przy użyciu technologii edukacyjnych, jego koncepcji teoretycznych i przedstawicieli; prezentację wyników wcześniejszych badań oraz efektów edukacyjnych adaptacyjnego (e)kształcenia i pewnych koncepcji adaptacyjnego kształcenia, które zostały niedawno opracowane na Uniwersytecie Ostrawskim.

S ł o w a   k l u c z o w e: kurs MOOC, kształcenie adaptacyjne, nauczanie adaptacyjne, style kształcenia, adaptacyjne narzędzia kształcenia, adaptacyjne systemy kształcenia, inteligentne kształcenie adaptacyjne, adaptacyjne hipermedialne systemy edukacyjne, adaptacyjny e-learning.

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Цели и содержание электронного модуля «Инструменты адаптивного обучения. Стили обучения» в рамках MOOC курса «ИКТ-инструменты для электронного обучения»

А н н о т а ц и я

В статье представлены цели и содержание образовательного модуля «Инструменты для адаптивного обучения. Стили обучения» в рамках MOOC курса «ИКТ-инструменты для электронного обучения», который разрабатывается в университете Остравы как результат проекта

IRNet. Основная цель курса состоит в том, чтобы познакомить преподавателей и студентов с теоретическими основами адаптивного обучения, что позволит им приобрести навыки, использовать существующие курсы в адаптивных электронных систем, и / или создавать новые курсы и системы. Содержание курса включает в себя следующие аспекты: определение основных понятий, используемых в курсе, обзор развития адаптивного обучения с использованием образовательных технологий, его теоретических концепций и представителей; представление результатов предыдущих исследований и образовательных эффектов адаптивного обучения, некоторые из концепций адаптивного обучения, которые недавно были разработаны в университете Остравы.

К л ю ч е в ы е   с л о в а: МООС курс, адаптивное обучение, стили обучения, адаптивные средства обучения, адаптивные обучающие системы, интеллектуальное адаптивное обучение, адаптивные образовательные системы гипермедиа, адаптивное электронное обучение

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Objetivos y contenido de módulo "Herramientas para el aprendizaje adaptativo. Estilos de Aprendizaje" en el marco del MOOC "Herramientas TIC para el E-Learning"

R e s u m e n

Este artículo presenta los objetivos y contenidos del módulo "Herramientas para el Aprendizaje Adaptativo. Estilos de Aprendizaje", dentro del MOOC "Herramientas TIC para el E-Learning" que se está desarrollando en la Universidad de Ostrava en el marco del proyecto europeo IRNET. El objetivo principal del curso es proporcionar al profesorado y al alumnado la base teórica del aprendizaje adaptativo que les permita adquirir habilidades, utilizar los cursos existentes en los e-sistemas adaptativos existentes y/o crear nuevos cursos y sistemas. El contenido del curso incluye lo siguiente: definición de los constructos básicos utilizados en el curso; visión general del desarrollo del aprendizaje adaptativo con el uso de tecnologías educativas, sus conceptos teóricos; presentación de los resultados de las investigaciones anteriores y efectos educativos del e-aprendizaje adaptativo, y algunos de los conceptos de aprendizaje adaptativo que se han desarrollado recientemente en la Universidad de Ostrava.

P a l a b r a s   c l a v e: MOOC, aprendizaje adaptativo, instrucción adaptativa, estilos de aprendizaje, herramientas de aprendizaje adaptativo, sistemas de aprendizaje adaptativo, aprendizaje adaptativo inteligente, sistemas educativos adaptativos hipermedia, e-learning adaptativo