

TEACHING ACTIVITY ANALYSIS AND SIMULATION SYNERGY FOR BETTER QUALITY OF EDUCATION

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Abstract

The objective of study was education system options such as Moodle. Education systems offer many activities with various procedures for implementation within a course. The benefit is an advantage of the relatively large variety of options, but the question stands on their utility and complexity of implementation. For the evaluation of individual activities, they must accept the dynamic and diverse needs of students. A good starting point is the variety of teaching materials and the addition of such activities such as Database, Glossary, or Link to file or web. An analysis of these options is realized by Petri Nets with support simulation. The profit is the availability of an additional analysis with an incidence matrix and reachable markings. Realized analysis confirms a less important of Database and Glossary activities compared with Link to file or web, or Test.

Key words: education, information, the Internet, knowledge, Petri Nets, simulation.

Introduction

The process of education is continuous. The need for education is visible regardless of age, gender, job title, or level of education achieved. Educational quality affects not only the quality of educational materials and teachers, but also the possibility of accommodating the personal preferences of a dynamic information society. These needs are pervasive and affect people's everyday activities. The availability of information is not a problem; the Internet offers a plethora of information for everybody and from anywhere. It is a great pity that information is not knowledge. We require knowledge about a given business area, as well as knowledge about software and hardware for the support of realized activities. Information technology products are ubiquitous, and information literacy creates differences in the ways of problem solving. Knowledge about given software and its use in practice for a better competitive advantage is one of the bases of success.

The educational environment uses the support of information technology on the basis of special education products, internet sources, and various forms of e-learning with support systems such as Moodle (Moodle). Standard structure of actual courses contains own teaching materials divided into chapters. Teaching materials are offered available in various formats. For adding teaching materials in Moodle system, the teacher has the menu "Add teaching materials". This menu disposes with items as Create legend, Create text page, Create web pages, Link to file or web. The Moodle system offers next learning activities to support interactive communication. These abilities are offered for teachers via the "Add an activity" menu with items like Public inquiry, Database, List of questions, Forum, Chat, Test, Wiki, Lesson, SCORM, Glossary. Teachers have these activities available in the form of a standard menu in "Edit" mode for a given course. Students are likely to take teaching materials in various forms. Public interest is aimed toward videos and simulations. The reason is that these materials are dynamic, incorporating visual effects.

Creative Learning and Innovative Teaching

The problems from the area of education are widely-known in the Czech Republic. Many papers, analyses, and scientific publications are dedicated to this subject area. The main barriers for systematic training and preferred directions of education are specified. (Adult Education in Czech Republic, 2009) These barriers are financial performance, little time, lack of motivation, low awareness, and a lack of confidence in the effectiveness of further education to find work. Knowledge and skills are needed for our everyday operations. The nature of business activities has changed. People rely on available information that transfer based tools, skills, and experience to knowledge with competitive advantage. Europe will need to reach an employment rate of almost 74% for the labor market demand to be satisfied. The goal of the Lisbon Strategy is currently 70%. (Future Skill Needs in Europe, 2009) In this situation, the request for optimal education with needed knowledge, competences, and skills grows more and more. The dismal fact still exists that there are discrepancies between existing and needed knowledge and skills. This situation causes a very dynamic development in our information global society. Education must respect conditions, requirements, and preferences. New methods of access and knowledge are required for creative learning and innovative teaching, namely: curricula, pedagogies and assessments, teacher education, **ICT and digital media, and educational culture and leadership.** (Cachia, R., Ferrari, A., Ala-Mutka, K., Punie, Y., 2010)

The role of knowledge is also important from the future view on development. Among the sources of economic growth in a globalized world economy, knowledge is arguably the most important one. (Knowledge Creation and Growth, 2010) In this context the level of education in the Czech Republic lags slightly behind the trend. For example, the average length of training is shorter (14.6 years - the EU average is 16.7 years), and education is less intense. (Hrabětová, 2001) The question is how to acquire needed knowledge and skills in a better and quicker manner. A similarly urgent question exists in the area of existing information technology products. The answer to this question is closely linked to education.

Better skills and knowledge of users are obtained in the learning process. The education has many ways for the resolution of given needs. First of all, teachers in modern classrooms are no longer lecturers, they are facilitators. Their main task is to set goals and organize the learning process accordingly. (Szucs, 2009) **The student must only start playing and regarding methods** of maintenance, setup, or production via relevant menus, commands, or links. Students have a personal preference and disposition to use offered materials. Designed teaching materials can be freely compared to web pages. One material can contain a number of links, images, animations, audio and video sequences, questions, or simply text. It only depends on the author of the material, which designs are selected.

Needs and Priorities in Education

There is great potential for open cooperation based on team building between student and tutor, tutor and student, student and student, tutor and tutor. Teachers showed priority to content knowledge (their subject) over the general characteristic features like 'empathy' or 'creativity'. (Szucs, 2009) **The empathy and creativity of education enable students to realize** their educational potential by creating a networked learning community. Their participants can easily access the information they need. Information technology offers new methods of education and a new level of understanding. Nowadays, specialists in very narrow fields have big advantages in comparison to those with more vague and broad qualifications, but because technology develops very quickly, „narrow” specialists are not able to keep up. (Amosava, 2011) The availability of a creative online environment is growing and it is increasingly taking the place in educational activities. We must also remember the preferences of the young generation.

This generation is network-oriented („net-centered”) and is able to use the web to create its own learning pathways that are customized to their pace, are available at request, and are customized to their needs. (Education in the Information Society) For example, M. Prensky (Prensky, 2011) identifies the main characteristics of net-generation students. They

- are used to getting information quickly,
- are familiar with multitasking,
- prefer graphics over text information,
- work better if they have a network (and can co-operate),
- are accustomed when work is linked to frequent evaluation and rewards (like in computer games).

The responsible teacher must optimally transmit a necessary quorum of information for further use of a selected information technology product with required methods and knowledge. Teachers must respect that the users (students) must have a skill set that allows him or her to probe and explore problems, to find and critically evaluate information, to work productively as a member of a team. (Colgoni & Eyles, 2010) **Education has tools for promoting and developing** the potential of each individual with the support of information technology. The question is which menus and activities are to be used for better education.

Methodology of Research

Petri Nets were chosen to analyze selected activities (Database, Glossary, and Link to file or web) from Moodle. **Petri Nets are primary used for simulation parallel and concurrent systems** to describe state changes in a system with transitions. The created model specifies important features of a given reality and they enable to better know the studied system. This analysis is centered on the description of parallelisms for selected teacher activities with classic analysis possibilities. This is the reason for select Petri Nets to **analyse on base simulation. Simulation** requires an executable and hence a formal model of the software. A graphical visualisation of the model is equally important to enhance the understanding of the software requirements. (Gold, 2004) The default structure of Petri Nets is defined as $\langle P, T, I, O, H \rangle$, where P is final set of places, T is final set of transitions, I are input functions, O are output functions, and H are inhibitory functions. Marking the Petri Nets is the multi-set over set of places:

$$\sum_{p \in P} M(p) \quad 'p = M(p1) \quad 'p1 + M(p2) \quad 'p2 + \dots + M(p|P|) \quad 'p|P| \text{ (Kochaničková, 2008)}$$

Classic analysis of Petri Nets for models is realized with incidence matrix and set of reachable markings. The definition incidence matrix is $C = O^T - I^T$ (Kochaničková, 2008). **Benefit** is easily demonstrated by offered activities and their confrontation.

Realized own models are created in simulating program of Petri Nets HPSim. (**Petri Nets Tools Database Quick Overview**) For correct analysis of real situations, object access is used. A created class of objects is defined by attributes and accessible methods. Net Objects are Transition, Place, and Arc. The model creator must draw needed places for available windows from Moodle, **transitions as ways to change through the menu, or buttons. Places and transitions** must be linked via oriented edges. Places are drawn as circles, transitions are rectangles, and edges are arcs.

Sample of Research and Data Analysis

The following rows show a practical application analysis with Petri Nets for creating a database as one of the available activities of the Moodle for the course “**Database Systems.**” The model describes the given reality with objects of Petri Nets; it is displayed in Figure 1.

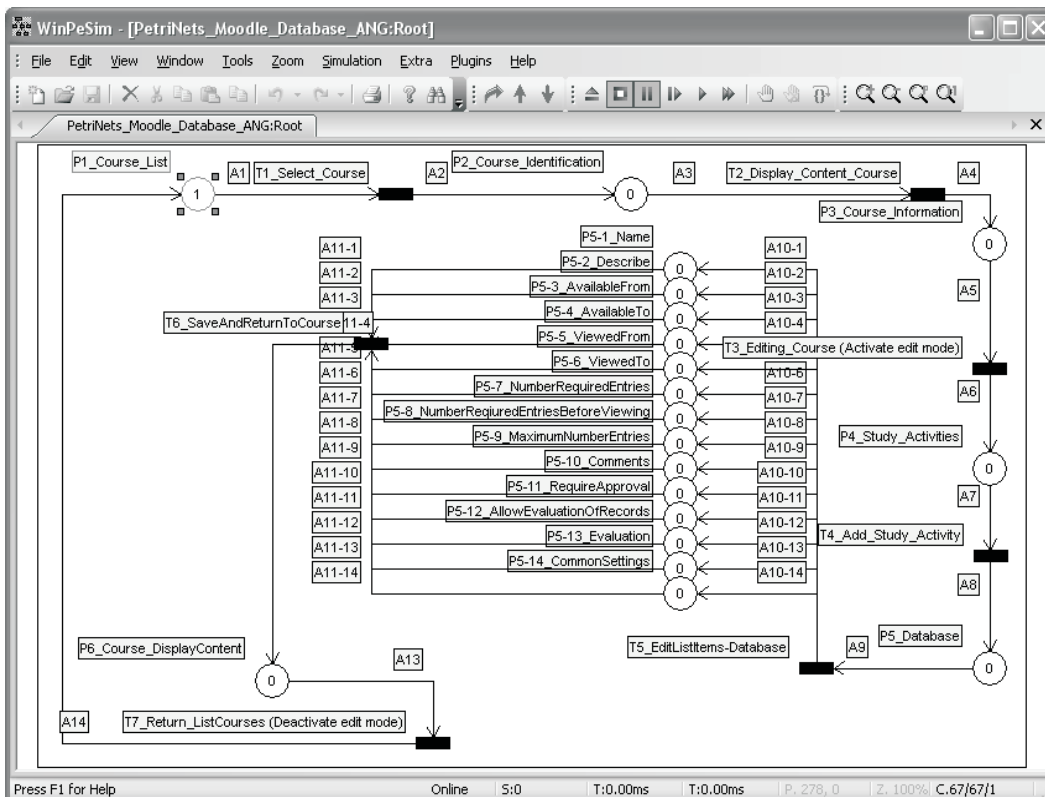


Figure 1: Method simulation for creating a database in Moodle (source: self-created model).

The start point is place Course_List (P1). This place displays the screen with registered courses of tutor. The next route leads through the transition Select_Course (T1) to place Course_Identification (P2). The transition rests in the selection of a course by the mouse and the scroll-bar. Place P2 displays on the screen a visually marked record of the course. Next steps are intuitive. Model build follows defined places:

- Course_List (P1) – displays a list of registered courses.
- Course_Identification (P2) – displays a visually marked name of the specified course.
- Course_Information (P3) – displays specified groups of information, materials, and activities for editing.
- Study_Activities (P4) – accesses offered activities.
- Database (P5) – accesses needed information about Database.
- Name (P5-1)... CommonSettings (P5-14) – accesses items for creation of database.
- Course_DisplayContent (P6) – displays actual information about the course.

Needed transitions of the defined model are:

- Select_Course (T1) – searches specified course (specified via scroll bar).
- Display_Content_Course (T2) – selects needed information about selected course (selects course by mouse).
- Editing_Course (T3) – specifies the edit mode of needed information, materials, and activities of a course (button Activate edit mode).
- Add_Study_Activity (T4) – specifies the menu for the creation needed

activities like a public inquiry, database, glossaries, tests, or Wikis (menu Add an activity).

- EditListItems-Database (T5) – accessible registered items for database creation.
- SaveAndReturnToCourse (T6) – confirms registered information created by edit process (button Save and Return to Course).
- Return_ListCourses (T7) – displays all registered courses of teacher for next course select (button Deactivate edit mode to end the editing).

Results of Research

The validity of the defined model is verified by starting the given simulation. A route cycle is built from place P1 via specified transitions and places. Places P5-1, P5-2, to P5-14 illustrate items for database editing. If the teacher ends the edit mode, it is important to confirm the “Deactivate edit mode” button. This activity is represented by transition T7. The next route returns to place P1. After creating the database for the first time, the teacher must build a new field. It is an easy activity because new fields are formed by selecting available items like Date, Image, File, Text (only one row), Text (more rows), or URL. A useful alternative is to select a file as an attachment or a link to a source on the Internet. The created model is a good starting point for further professional analysis. This analysis is used in a standard way with an incidence matrix and set of reachable markings. To illustrate the incidence matrix and the reachable markings, please see Table 1.

Table 1. An analysis for a model with an incidence matrix and reachable markings.

Incidence matrix								t1→M1	t2→M2	t3→M3	t4→M4	t5→M5	t6→M6	t7→M0
	t1	t2	t3	t4	t5	t6	t7	M0	M1	M2	M3	M4	M5	M6
p1	-1	0	0	0	0	0	1	1	0	0	0	0	0	0
p2	1	-1	0	0	0	0	0	0	1	0	0	0	0	0
p3	0	1	-1	0	0	0	0	0	0	1	0	0	0	0
p4	0	0	1	-1	0	0	0	0	0	0	1	0	0	0
p5	0	0	0	1	-1	0	0	0	0	0	0	1	0	0
p5-1	0	0	0	0	1	-1	0	0	0	0	0	0	1	0
p5-2	0	0	0	0	1	-1	0	0	0	0	0	0	1	0
p5-3	0	0	0	0	1	-1	0	0	0	0	0	0	1	0
p5-4	0	0	0	0	1	-1	0	0	0	0	0	0	1	0
p5-5	0	0	0	0	1	-1	0	0	0	0	0	0	1	0
p5-6	0	0	0	0	1	-1	0	0	0	0	0	0	1	0
p5-7	0	0	0	0	1	-1	0	0	0	0	0	0	1	0
p5-8	0	0	0	0	1	-1	0	0	0	0	0	0	1	0
p5-9	0	0	0	0	1	-1	0	0	0	0	0	0	1	0
p5-10	0	0	0	0	1	-1	0	0	0	0	0	0	1	0
p5-11	0	0	0	0	1	-1	0	0	0	0	0	0	1	0
p5-12	0	0	0	0	1	-1	0	0	0	0	0	0	1	0
p5-13	0	0	0	0	1	-1	0	0	0	0	0	0	1	0
p5-14	0	0	0	0	1	-1	0	0	0	0	0	0	1	0
p6	0	0	0	0	0	1	-1	0	0	0	0	0	0	1

Accordingly, the analysis of other teacher activities from Moodle (such as Glossary, Test, or Link to file or web) is available. For example, creating glossaries involves approximately the same volume of work. There are sixteen items to specification of the Name, Description, Glossary type, Display alphabet, or Evaluation with mark.

Discussion

Moodle analysis is dedicated study like “The beginning of electronic testing of students of the English Department” from Masaryk University in Brno. (Fictumová & Mikšik, 2004) Analysis interest is focused on electronic testing, and comparison electronic and standard tests. Experiences from electronic testing were positive, and authors decided about transfer to this form future examines test. The new method brought time savings, greater objectivity, and flexibility. Another study from CTU in Prague “Using Moodle to support e-learning Software Project Management course” analyzes experience with support teaching (Kubeš, 2005). Author appreciates that distribution of materials was practical and save time. The course included description, needed links to teaching materials, questions and tests. In both cases, teacher activity as “Link to file or web” is used with enthusiasm. The teacher must only specify items like Name, Describe, Link to file or URL. On the other hand, “Database” activity is not used, because it is not such useful. It would be appropriate to merge the Database with other activities (as Glossary). Database is used for storing various data and their further processing. The Database has high potential in relation to information systems. These procedures also create free space to add availability for creating simple recording.

Conclusions

Dynamic and global influences have reached our lives, business activities, firms, organizations, and society. These influences must lead into dynamic and global changes in education. The barriers and needs of students are well-known. Users demand quick resolutions of their own and social preferences. The problem is how education secures many different preferences. The important requirement is to have optimal knowledge and skills. A good resolution is variability and visual occurrence in supporting simulations and video recordings. Teachers must use a wide spectrum of study materials and activities. For example, the Moodle education system offers an interested person more than fifteen options to access educational materials, but all are not equally useful. An effective and frequently used menu is the “Link to file or web” activity. The teacher must specify only three fields. More effort must be made by the teacher in creating Database or Glossary. These activities are specified by fourteen to sixteen items. The effects of both activities are almost identical. It would be best to consolidate these activities and add a recording option.

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