ENHANCED TEACHING STRATEGIES
The Design Process of a Support System for Teachers

Narin Akrawi
Department of Informatics and Media, Uppsala University, Kyrkogårdsgatan 10 B, Uppsala, Sweden

Keywords: Computer-based Teacher Support, Teacher Education, Teaching Strategy, Bloom's Taxonomy.

Abstract: In this paper we present the design process of a knowledge-based system, called Mentor. When designing Mentor, our aim is to give the teachers opportunity to reflect upon their current teaching strategies and provide guidance on how to improve their teaching. The purpose of emphasizing the design process for Mentor is to identify, capture and validate, at an early stage, important pedagogical aspects. A thorough design process will help us to implement a system according to the users' requirements regarding functionality and the users' interaction with the system. In Mentor Bloom's revised taxonomy is used as a basis for classification of different objectives and skills that educators need to reflect upon in facilitating a student-centred learning environment (SCL). Moreover, the revised taxonomy is used to relate the teachers' teaching strategies to the taxonomy and as a basis for generating feedback to the teacher. This feedback is individualized since it is related to the information the teacher has provided the system concerning his/her teaching. The result of tests showed that Mentor could be used as a tool for provoking teachers' reflections at all level of the educational system.

1 INTRODUCTION

Growing and working in the information age has promoted learning and problem-solving for various learning communities (Spector, 2008). One of the communities is the educational organization, which has endeavoured to put students at the centre of the learning. Despite this demand on schools many teachers continue to use a teacher-centred approach when educating students (Lea et al., 2003; O'Neill & McMahon, 2005). Student's active learning is supported in a SCL environment. In this type of learning environment, the main task is to promote students' learning by giving them more control over their own learning and disseminating new knowledge and skills (Alagic, 2004).

In a traditional class environment, the interaction between teacher and students is restricted and "the teacher is holding the power to knowledge, the power to deliver the knowledge, and the power to control the learning and teaching environment" (Kasim & Ali, 2007). On the contrary, in a SCL, teachers become facilitators, and encourage students to interact and help other and learn from each other. This form of teaching creates healthy communications between teacher and students. Some authors argue that such communication becomes more effective when integrated with Information and Communication Technologies (ICT). The educational improvement demands educators to rethink and re-evaluate their perception about their knowledge and expertise in the field of teaching (Kraus et al., 2001; Sweder, 2002). However, rethinking and revaluating one's own expertise critically, is a difficult task (Kjellin & Stenfors, 2002). Unfortunately, teachers, who are trying to integrate and use new teaching methods differing from traditional ones, are often met by resistance by their colleagues as well as by students (Hedin, 2006). Utilizing information and communication technology in form of, e.g., a knowledge-based system, the teacher could explore new teaching strategies before implementing these strategies in the classroom. In this paper we present the design process of a knowledge-based system, called Mentor. The aim is to give the teachers opportunity to reflect upon their current teaching strategies and provide guidance on how to improve their teaching. . In turn, this can influence their classroom leadership style. The design proposal focuses on the requirements regarding the functionality of the system.

Akrawi N. (2010).
ENHANCED TEACHING STRATEGIES - The Design Process of a Support System for Teachers.
In *Proceedings of the 2nd International Conference on Computer Supported Education*, pages 72-81
DOI: 10.5220/0002781200720081

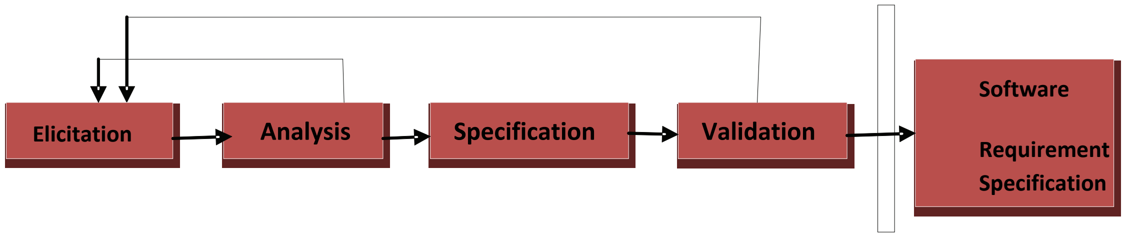

Figure 1: The process of capturing requirements (Pfleeger & Atlee, 2006).

Our purpose of emphasizing the design process for Mentor is to identify, capture and validate, at an early stage, important pedagogical aspects. As it is vital to involve domain experts and end-users when designing and implementing systems supporting learning, we have collaborated with teachers and pedagogues with expertise within information technology. A thorough design process will help us to implement a system according to the users' requirements regarding functionality and the users' interaction with the system.

Thus, to support teachers to improve the quality of their teaching and to move toward a more student-centred learning environment we designed Mentor. By offering such a system we believe that teachers will get new insights into new teaching strategies and will hopefully adapt their teaching strategies in accordance to the new approaches.

This paper is organized as follows. In section 2 a brief introduction to design process is given. Sections 2.1 to 2.3 describe the process of capturing and validating the requirements in the system design. In sections 3 the design of Mentor has been presented. Finally, the results of the validation, as well as, the concluding discussions are summarized in section 4.

2 THE DESIGN PROCESS

According to some researchers, among them Gero and Sudweeks (1997), a design process is a knowledge intensive activity. These authors argue that studying a design problem requires knowledge across different disciplines and sources, for instance knowledge spread between many experts, publications and databases (ibid.). However, transforming this knowledge into a working system requires that the designers find the relevant knowledge, as well as, assure customers' need and, at the same time, make it possible for the system developer to understand how the system should work (Pfleeger and Atlee, 2006). The design process is an iterative process, in which the designer moves back and forth between different activities to understand the requirements (Gero & Sudweeks, 1997).

The first step in the development of a system design is the process of capturing requirements. Requirement engineering is considered by many authors as one of the most significant parts of any software project (cf. e.g., Lehner & Hofmann, 2001; Sommerville, 2004; Pfleeger & Atlee, 2006). If the users' requirements are not clearly understood the errors can result in an extensive rework when discovered at later phases (Pfleeger & Atlee, 2006). For this reason we have emphasized this part when designing the system proposals. In this regard, a prototype of the system can be useful to understand the requirements and see what requirements are missing or to evaluate design alternatives. There are two kinds of requirements: functional and non-functional. Functional requirements define the interaction between the system and its environment and emphasize the functionality of the system. Non-functional requirements describe a restriction on the system that limits our choices on the product to be developed (ibid.). In our system design proposals we have focused on the functional requirement.

In order to design Mentor, as for all new systems, we started the requirement process for Mentor with a feasibility study. According to Sommerville (2004) a feasibility study is a short and focused study aimed at answering questions e.g., "Does the system contribute to the overall objectives of the organization?" This question is critical since if the system does not contribute to the overall objectives then it has no value (ibid.). The result of the feasibility analysis showed that there is a need for this kind of system. For capturing requirements

For the design of Mentor we utilized the approach seen in Figure 1. The first step in the capturing requirements is the process of elicitation. In this process the user's requirements are collected and then analyzed.

2.1 Elicitation and Analysis

During the requirement elicitation activity, a system or knowledge engineer uses different techniques such as literature review, observations, interviews, questionnaires, focus groups, use cases, and prototypes to discover requirements and gather necessary information about the application domain, what services the system should provide, the requirement performance of the system etc (Pfleeger and Atlee, 2006.). The elicitation and analysis can be seen as an iterative process, where the collected user requirements are analyzed and the result from the analysis is input in a new elicitation activity. During these activities the system engineer tries to get a clear picture of the collected user requirements, which will later be specified in a requirement specification. Through the requirement specification the communication with customers, as well as, the maintenance of the requirements and the system gets easier.

The methods chosen for the elicitation in the project are literature review, observations, interviews, and focus groups. The work with Mentor started by conducting a literature review to study relevant literature about the central topics in our research such as learning, teaching, learning styles, Bloom's revised taxonomy (Anderson & Krathwohl, 2001) and knowledge-based systems. This literature review was conducted to enhance our knowledge about these subjects, to frame our work and to be able to compare our work with those of others. Moreover, through this literature review we tried to give the readers the core idea of our research.

To collect data about the opinions, the needs and the requirements for Mentor we used observations, interviews and focus groups. Observation is considered as one of the common methods for qualitative data collection and can be conducted either by direct observation or participant observation (Trochim, 2006). To assure that the observations are of the natural phenomenon, the researchers should be involved as "involved researcher"(Walsham, 2006) in the daily activities of the observed situation. As involved researcher, we got a close involvement, which helped us to gain an in-depth understanding of the situation. We found that the educational system in Kurdistan is basically based on the teacher-centered approach where the teacher has the total control in the classroom. Kurdistan, as many other countries, has realized the need for a school reform, which should be toward a more SCL environment (Mayiwar et al., 2005). To start the reform, educational experts were invited to Kurdistan including professors from Department of Educational Administration and Leadership, College of Education at Tennessee State University, USA. The most important elements in the reform considered to be teachers' leadership style and their ways of teaching. These facts, gave us the idea of designing Mentor. As I live in northern Iraq and teach at the College of Engineering at Salahaddin University I observed the situation very carefully and became a part of the daily activities in the observed situation. As a part of the teaching staff I was allowed to attend my colleagues' lectures and labs. We also cooperated in and between our courses, e.g., in my course the students will learn the process of software engineering from requirement gathering phase to the design phase and learn to implement the requirements at another course. Through this cooperation it was easier for me to notice the other teachers' teaching strategy, as well as, their leadership style in the classroom. The result of my observations showed that the most of the teachers were accustomed to one leadership style, the autocratic one and the teaching strategies are based on this autocratic view of teaching. The reason for this might be that they, themselves, have been taught by autocratic leaders and therefore are not trained as democratic leaders. Therefore it is vital to provide these leaders with effective models of alternative leadership styles and teaching strategies.

Moreover, we interviewed the president of the University, the dean of the Department of Engineering and the dean of Department of education. The result of our interviews showed the same result as our observations. They addressed an enormous need for a change in the educational settings. The president of Salahaddin University stressed "we seek the thinking, approaches, tools, and skills that will equip an increasing portion of our student body with leadership and management capabilities that will effectively address the needs of all segments of our society in every corner of our region. It is this focus on, and commitment to, the public interest that has yet to become the professional interest of our students and graduates." He also added "achieving this objective requires teachers to rethink critically regarding their current leadership and teaching styles".

To get help with pedagogical issues for designing Mentor we contacted the experts at the institute, VLM (Virtual Learning Environment) at Uppsala, Sweden. After discussing our idea with people at VLM we were directed to the Regional Centre for the Coordination of Pedagogical

Development (RCCPD). The main objective of this organization is to assemble people with pedagogical knowledge to help each other to change and improve the educational system regarding the needs and requirements. At the first interview with the project leader at RCCPD we introduced the purpose of the thesis in general and the purpose of designing Mentor in particular. We also asked about existing systems and whether they saw a need for the system that we aimed at designing. The result of this interview showed that despite the great emphasis on education in Sweden, schools have not yet succeed in creating suitable student-centred classrooms.

To get further and more accurate information and to gather requirements, the project leader at RCCPD set up a focus group interview with other experts who shared common experiences and expertise about teaching. At the first focus group we presented the research topics and introduced our main idea for the group. Topics such as knowledge-based systems, Bloom's revised taxonomy, which we planned as a method in our system, were discussed. Bloom's revised taxonomy is applied in Mentor to classify different objectives and skills that educators need to reflect upon to support students' deep learning. We have chosen the revised Bloom's taxonomy in Mentor of two main reasons: the first is to be able to map teachers' answers to the taxonomy and the second is to give the teachers different kind of feedback based on the educational objectives in the taxonomy.

Additionally, I shared my experiences of teaching at Salahaddin University in northern Iraq. These topics and ideas put the foundation for the questions that were asked. To facilitate the respondents' answers and their point of view we prepared open-ended questions in advance.

At the second focus group interview, we presented a set of questions related to teaching strategies that we had found on UCIrvine Instructional Resources Centre's website. A set of eighteen questions, regarding design of courses has been set up on this site. The set is adapted from an article by K.T. Brinko, published in "The Teaching Professor" (Brinko, 1991).

The gathered requirements often results in a large set of raw requirements that due to cost and time limitations cannot completely be implemented in the system (Parvianien et al., 2003). Therefore, after discussions and analysis of these questions at two additional focus groups, we decided to utilize questions 1-9 in our support system. The first five questions were further studied and analyzed in detail by one of the experts. We also further developed these questions and divided them in different levels to be able to implement them properly in form of rules in a coming system.

2.2 Specification

One convenient technique to determine the functional requirements for a system is to identify use cases (Pfleeger, 2001). A use case "describes particular functionality that a system is supposed to perform or exhibit by modelling the dialog that the user, external system, or other entity will have with the system to be developed" (ibid.). By using a use case the communication between customer, system developer, and tester becomes much easier. Therefore, we have utilized this technique when designing Mentor. One example of a use case used in the design of the system prototype can be seen in Appendix 1. Through this use case, the main interaction with the system has been specified.

2.3 Validation

To show that the requirements do define the system that the customer wants we validated the gathered requirements. This phase is very important since errors in requirements can result in extensive rework costs when discovered at later phases (Pfleenger and Atlee, 2006). There are different techniques for validation of requirement such as requirements reviews, inspection, reading techniques, model-based requirements validation, and testing-based requirements validation, and prototyping (Ahmad & Saqi, 2008).

Prototyping is a technique, which makes requirements more tangible. Through a prototype requirements can be demonstrated which makes it easier to find problems and give suggestions for how the requirements can be improved. The prototype can be in different forms e.g., static, paper-based prototype or interactive software-based prototype (Dumas & Redish, 1999). Paper-based prototyping is considered to be effective to involve users in the design process early by showing users screen images on paper and visualize how the product will look like and let them to try the prototype (ibid.). One drawback with these kinds of prototyping is that they are slow. In an interactive software-based prototype the designer can simulate the look and feel of a software user interface quickly. This technique makes it easier for the designers to discover problems and make changes before it is too late (ibid.).

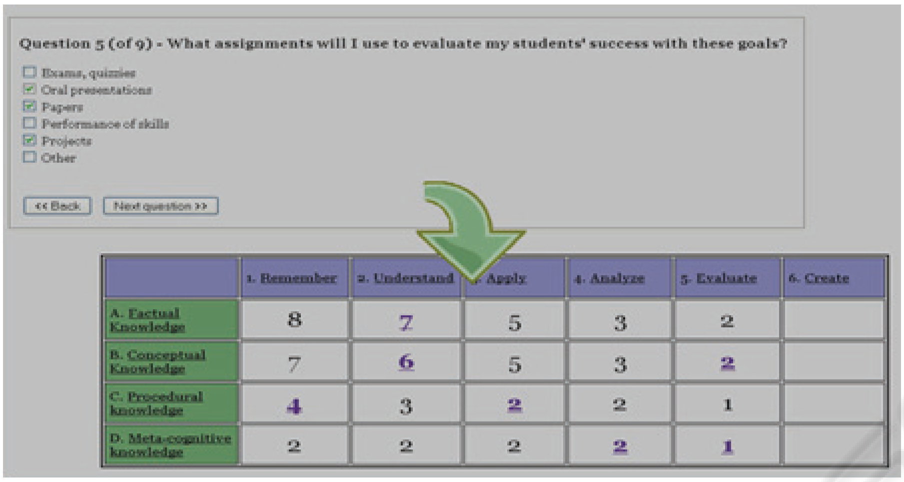

Figure 2: Question 5 in relation to taxonomy.

We chose an interactive software-based prototyping to visualize requirements and also to identify problems at an early stage. A researcher who has been involved in the project and a teacher, at the Department of Informatics and Media, at Uppsala University, organized the tests. Tests can be considered to be more reliable when carried out by other than the researcher because then he/she will not have any influence at the test. In the first test two IT-pedagogues employed at the municipality of Uppsala and active at VLM were participating. In the second group the project leader, as well as, the project assistant at the RCCPD contributed. It is worth to note that the testers have been involved in the project previously and helped us with the pedagogical knowledge. It has been proved that tests performed by a group of two persons are more fruitful since they can have a discussion. Through discussions more information can be obtained ((Durkin, 1994; Awad & Ghaziri, 2004).

The tests were performed in a usability test lab where the entire sessions have been recorded. The test persons' activities e.g., what they saw at the interface, the way they worked with the system, as well as their comments and reactions were recorded. After finishing the session the tests were finalized by asking follow-up questions to get additional important information. Moreover, after each test the prototype was further developed in accordance to the testers' comments and suggestions. The result of the tests is presented in section 4.

3 THE DESIGN OF MENTOR

In this section we present the design of the knowledge-based system Mentor. We have utilized 9 of the 18 questions At UCIrvine Instructional Resources Centres' website regarding design of courses (Mayiwar & Edman, 2007):

1. What are my course goals? What do I want my students to learn primarily?
2. At what level (s) do I want my students to perform?
3. What class activities will help my students to meet these goals and levels?
4. How will I support my students in their efforts to meet these goals and levels?
5. What assignments will I use to evaluate my students' success with these goals?
6. How much uniformity of assignments will best serve my students' need?
7. What evaluation approach will best help my students to meet these goals and needs?
8. What evaluation unit for each assignment is consonant with these and levels?
9. What type of class atmosphere will foster students' success?

In Figure 2 one of the questions is given with different alternatives and the chosen alternatives are marked. In order to motivate the teacher, the system starts with a brief presentation of the main ideas with using the system. Then the user will be given a set of multiple choice questions related to teaching methods (See Figure 2).

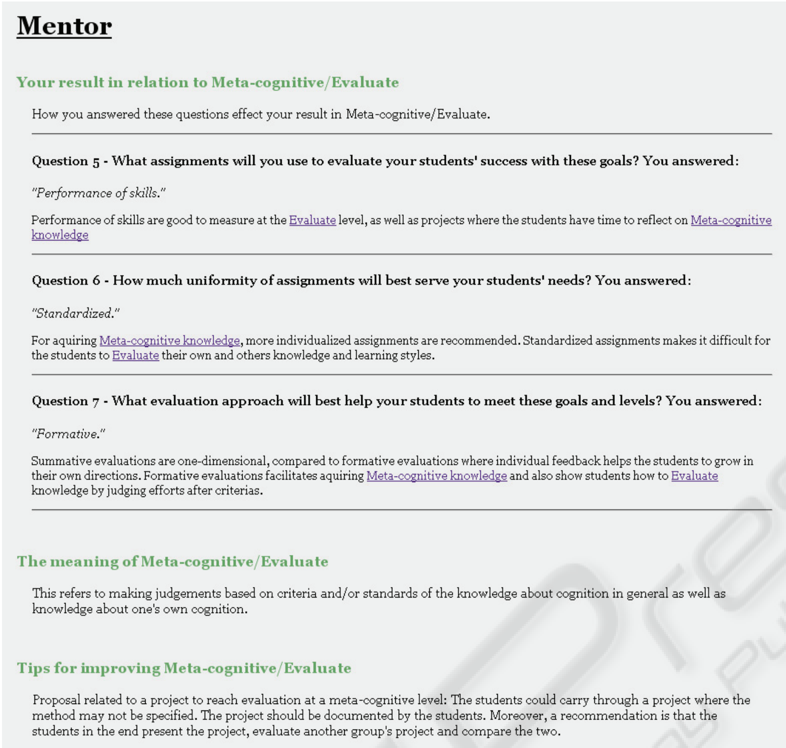

Figure 3: Different kinds of feedback in relation to Meta-cognitive /Evaluate.

Every answer will be interpreted and mapped to the revised Bloom's taxonomy. When the user has finished a session the system will present an overview of how the answers have been evaluated according to the taxonomy, giving the number of matches in each square. Through this presentation the user can get an insight into their teaching method, which hopefully will lead to personal reflections. Additionally, feedback will be generated upon user's request (See figure 3). Two kinds of feedback can be presented. The first one is dynamically generated in relation to the user's result and the other one is general and explains different objectives in the taxonomy and also gives suggestions about teaching.

As mentioned earlier the main goal for designing Mentor is that it should support the teacher's reflection over their current teaching strategies and to give new insight into other strategies. We believe that teacher could be supported by different kinds of feedback and explanations.

4 RESULT AND DISCUSSIONS

The collected and validated requirements were, as described above, documented in a requirement specification in form of use case. This uses case were utilized for designing prototypes of Mentor. Furthermore, the prototypes were tested on two groups. The aim was to check the following aspects presented in Sommerville (2004):

1. *Validity Checks*: checks were conducted to confirm whether the system provides the functions, which best support customers need. In this regard, the mixed-initiative dialogues, feedback given by the system, the set of the questions, the way of working with the system, and the presented result in accordance to Bloom's revised taxonomy were evaluated. Moreover, the systems' suitability as a tool to support teachers' reflections about their teaching strategies was studied.
2. *Consistency Checks*: the requirements described in the document should not be conflicting, which means that it should not be any contradictory or constraints or descriptions of the same function. The testers checked if the test persons found any contradictions between questions, multiple choices, tips and the feedback presented in the system.
3. *Completeness Checks*: the requirements document should be completed by all functions and constraints set by the user. For this reason, the test persons were asked if there is some additional

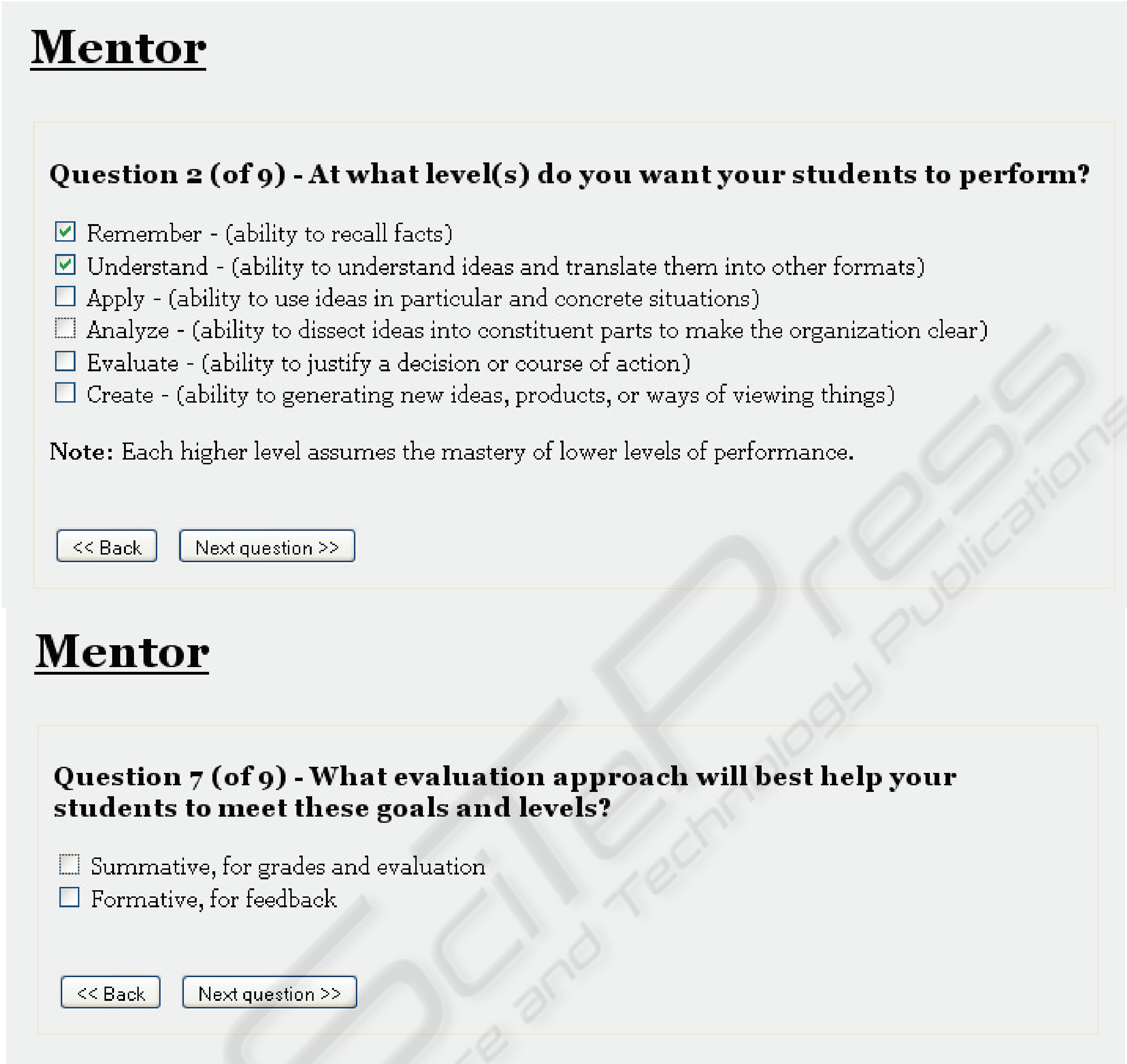

Figure 4: Questions 2 & 7 in Mentor.

functionality, explanations, or questions to be added to the system.

4. *Realism Checks*: the requirements should be checked whether they could be implemented after studying existing technology. In this regard, time, cost, possible financiers were considered.

5. *Verifiability Checks*: the system requirements must be written in a verifiable way. This means that a set of tests through which we show that the system meets each specified requirements must be written. The aim of this documentation is to decrease the potential disagreement between customer and contractor. The use cases were further studied to make them as easy as possible to facilitate the communication between the users and the developer.

Two groups of test persons have evaluated the design of Mentor as described in chapter 4. The result of the evaluation showed that this system could be used as a tool for school leaders at all levels in the educational system. Some comments from the tests are:

"The system is a tool that provokes reflections".
"This system can be used as a tool to make the way we run our schools visible and help us to reflect upon it."

The test persons believe that teachers play the central role in any educational system. They state that even if we change the educational system at national level e.g., the curriculum yet the goals will not be achieved until teachers' teaching strategies are adapted to the new approach.

"When we try to make changes at a national level, teachers are still living in the autocratic system. Then we have a commission that is changed. So now the individual must change themselves."

Furthermore, the feedback given by the system in form of explanations and tips was very useful and essential for teachers' reflection, according to the test persons.

"I found the feedback given by the system very useful since I don't need to remember all of it."
"I am impressed of the presented feedback. It is really appreciated."
"In the traditional teaching environment often teachers are alone. When they need feedback on a particular issue they can use the system and through the feedback and presented tips find out how to move on."
"Internal discussions performed by oneself can be poor therefore the system will work better if we work as a group when using it."

By analyzing the result of the evaluation we found some problems and suggestions for the improvement. The first problem is that the definition of the knowledge dimension and cognitive process dimension in the Bloom's revised taxonomy must be further developed to be better understood. One suggestion is to have three to four different definitions for each concept and one additional free definition so that the user can be able to define the concept in his/her way. The second problem was the given feedback in form of numbers in the taxonomy. The numbers are difficult to interpret and understand. Moreover, it is not necessary to evaluate what is stored in the system. Suggestion was to use other signs to give the feedback. The third problem is the contradictions in question 2 & 7 (See Figure 4). For the question 2 is given that if you e.g., mark "Create" according to the note then it means that all the previous options are also marked.

Having follow-up questions would reduce this problem. Question 7 was also difficult to answer since it is not clear what summative and formative evaluation is. One reflection is that every teacher must choose both of the options to fulfil the course goal.

The forth problem is that there are no questions on how to motivate students. One suggestion is to motivate students to take examples from their daily life to learn from. This is considered to be in accordance to the student-centred approach.

The following suggestions have been given to improve the design:

1. Add more questions and follow-up questions to the system and use different colours for follow-up questions.
2. Add questions that help teachers to motivate students.
3. Add information about learner's strategies in the follow-up questions.
4. Add information about how questions are related to each other.
5. Remove the numbers in the taxonomy and use other types of graphical feedback.
6. Define the concepts in the taxonomy more thoroughly and give different options of one definition. Moreover, give the users the opportunity to add their own definition.
7. Provide users with two different views of the system. One for planning the teaching and one for reviewing.
8. Give the user opportunity to watch a video about another teacher's teaching situation.
9. Translate the system to Swedish.

As mentioned earlier the aim for this paper was to put a solid foundation for the design of Mentor, a knowledge-based system for teachers' learning. In the past decades there have been new demands on teachers. One of the biggest challenges has been to reflect upon their current teaching strategies and try to move toward more student-centred teaching strategies. Studies show that despite great emphasis on student-centred teaching, there are still many teachers who continue to teach in the traditional teacher-centred way. Moreover, teachers, who are trying to integrate and use new teaching methods differing from traditional ones, are often met by resistance by their colleagues as well as by students (Hedin, 2006). Utilizing information and communication technology in form of, e.g., a knowledge-based system, the teacher could explore new teaching strategies before implementing these strategies in the classroom. In order to provide a knowledge-based system that meet teachers' need we have focused on the process of capturing requirements in this paper. This process is considered to be the most important part when designing a system. Since, the success of an implemented system is depended on clear and well-defined requirements. Through the presented design process we have got good support for the implementation of the design in a working system.

REFERENCES

Alagic, M., Gibson, K. & Doyle, C. (2004). The Potential for Autonomous Learning through ICT. *Society for Information Technology and Teacher Education International Conference. 2004(1),* 1679-1684. (available online) http://dl.aace.org/14560 [June, 2008]

Anderson, L.W., & Krathwohl D.R., (2001). *A Taxonomy for Learning, Teaching, and Assessing: A Revision of Bloom's Taxonomy of Educational Objectives*. New York: Longman.

Awad, E. & Ghaziri, H. (2003). *Knowledge management*. Pearson & Prentice Hall.

Brinko, K.T. (1991). The interactions of teaching improvement. *In teaching. New Directions in Teaching and Learning, No. 48.* San Francisco, CA: Jossey-Bass.

Dumas, J. S., Redish, J. C. (1999) A practical guide to usibility testing. Revised Edition. Intellect books.

Durkin, J. (1994): *Expert systems, design and development*. Prentice Hall.

Edman, A., Mayiwar, N.(2003) A Knowledge-Based Hypermedia Architecture Supporting Different Intelligences and Learning Styles. *Proceedings of the eleventh PEG2003 Conference*. Powerful ICT for Teaching and Learning, St. Petersburg, Russia.

Gero J., Sudweeks, F., (1994) Book review Artificial intelligence in design '94 by (Eds.), Kluwer Academic Publishers, Dordrecht, 1994. pp 768, ISBN 0-7923-2994-5. http://journals.cambridge.org/ Retrieved August 2008.

Gobet, F. & Wood, D. (1999) Expertise, models of learning and computer-based tutoring. *Computers & Education* 33.

Hedin, A., (2006) *Lärande på hög nivå* – idéer från studenter, lärare och pedagogisk forskning som stöd för utveckling av universitetsundervisning (*Learning on a high level* – ideas from students, teachers and pedagogical reserach as support for university teaching). Uppsala University.

Hofmann H. F., , Lehner, F., (2001), Requirements Engineering as a Success Factor in Software Projects, *IEEE Software, vol. 18(4)* pp. 58-66, July/Aug.

Kassim H., Ali Z. (2007) The Use of ICT in the Implementation of Student-Centered Learning (SCL*). Internet Journal of e-Language Learning & Teaching, 4(1),* January 2007, pp. 15-31.

Kjellin, H., Stenfors, T.(2002) Harald Kjellin, Terese Stenfors, A Process for Acquiring Knowledge While Sharing Knowledge, *Proceedings of Fourth International Conference on Practical Aspects of Knowledge Management, 2-3 December*, Vienna, Austria.

Kraus, L.A., Reed, W.M. & Fitzgerald, G.E. (2001) The effects of learning styles and hypermedia prior experience on behavioral disorders knowledge and time on task: A case-based hypermedia environment. *Computers in Human Behavior* 17, 125-140.

Lea, S. J., D. Stephenson, and J. Troy (2003). Higher Education Students' Attitudes to Student Centred Learning: Beyond 'educational bulimia'. Studies in Higher Education 28(3), 321–334.

Mccombs, B. L. and Vakili, D. (2005) A Learner-Centred Framework for E-Learning. *The Teachers College Record, Volume 107* (8), August 2005, pp. 1582-1600(19) Blackwell Publishing.

Marton, F., Hounsell, D. & Entwistle, N. (1996) Hur vi lär (*The Experience of Learning)*, Stockholm: Rabén Prisma.

Mayiwar, N., Edman, A. (2007) Mentor- knowledge Management System Supporting Teachers in Their Leadership. *Proceedings of NBE conference.* Roveniami Finland

Mayiwar, N., Pritchett, W. P, Edman, A. Wiemers, R. (2005) Improving Leadership Styles Using Technology. The *Journal of Interdisciplinary Education* (JIE) a peer-reviewed journal associated with the North American Chapter of the World Council for Curriculum and Instruction.Vol. 7, No. 1.

Morphew, V.N. (2002) *Web-Based Instructional Learning*/[Edited by] Mehdi Khosrow-Pour. USA: IRM Press

MacNeill, N., Cavanagh, R., Silcox, S. (2003) Beyond Instructional Leadership: Towards Pedagogic Leadership. *Proceedings of annual conference for the Australian Association for Research in Education*, School renewal: recurrent themes about educative mission, pedagogy and leadership. Auckland.

O'Neill, G. and McMahon T. (2005) Student–centered Learning: What Does It Mean for Students and Lecturers? Publisher: *All Ireland Society for Higher Education (AISHE)*, Dublin.

Pfleeger , S. L. and Atlee, J. (2006). *Software Engineering. Theory and Practice*. Third Edition. Pearson International Edition.

Parviainen, P., Hulkko, H., Kääriäinen, J., Takalo, J. & Tihinen, M. (2003). *Requirements Engineering. Inventory of Technologies.* VTT Publications. Espoo.

Saqi, S. B., Ahmad, S., (2008) *Requirements Validation Techniques Practiced in Industry: Studies of Six Companies.* Master Thesis in Software Engineering. School of Engineering. Blekinge Institute of Technology, Sweden. Thesis no: MSE-2008-23. Available online: http://www.bth.se/fou/cuppsats.nsf/bbb56322b274389dc1256608004f052b/03a48c3772d5b49ac12574ff002e6fd4!OpenDocument

Spectro, J.M., (2008) Cognition and learning in the digital age: Promising research and practice. *Computers in Human Behavior 24*. 249–262.

Sommerville, I. (2004) *Software engineering*. Addison-Wesley, Fifth Edition.

Sweder, Lucianne. (Website, 2002). *Teachers That Impart Technology Make a Difference for Student* Part 1 of 2. FET Connection. Gorge Ortega. Managing Editor. Florida Educational Technology Corporation. Available on http://www.fetc.org/fetcon/2002-FallSweder.cfm. Retrieved on October 18, 2005.

Trochim, MK., W. (2006) Qualitative approaches. Available at: http://www.socialresearchmethods.net.

Walsham, G. (2006) Doing interpretive research. *European Journal of Information Systems*, 15 (3), 320-330.

APPENDIX

Use case: Reflect upon ones teaching strategies

Scope: Mentor **Level**: User goal
Primary Actor: - Teacher, school and university
Stakeholders and interests: Principals, University teachers training teachers, Students and Parents of students
Preconditions: The user has an account in Mentor.
Success Guarantee (Post conditions:
The user should have answered all questions and gotten feedback. Answers and results should have been saved in the system. The user should have logged out.

Main Success Scenario (Basic Flow):
1. User logs in to Mentor, providing identification information.
2. System returns the start page, presenting the purpose of Mentor.
3. User confirms that he/she has read the information by proceeding to the next page.
4. System presents Blooms revised taxonomy, showing the cognitive dimension and the knowledge dimension, with links to definitions.
5. User explores the definitions in Blooms revised taxonomy.
6. System presents definitions.
User repeats step 3-4 until he/she is satisfied.
7. User confirms that he/she has understood the definitions by proceeding to the next page.
8. System presents the connection between the questions and the taxonomy.
9. User confirms understanding by proceeding to the next page.
10. System presents a multiple choice question with different answers.
11. User answers the question and proceeds to the next page.
System and user repeat step 10-11 for all nine questions.
12. System presents the result, where the answers are mapped to Blooms revised taxonomy through numbers for each combination of dimension items.
13. User explores a combination number.
14. System presents individual feedback depending on the user's answers as well as general information about definitions and tips for improving the current combination of dimension items.
User repeats step 13-14 until he/she is satisfied.
15. User chooses to save his/her answers and result.
16. System saves the answers and the result.
17. User chooses to log out of the system.
18. System logs out the user automatically.

Extensions (Alternative Flows):
*a. At any time, the user can choose to return to a previous page.
1. System presents the previous page.

11a User chooses to return to a previous answer to change his/her answers.
1. System presents the previous question and shows the previous answers.
2. User changes answers to the question.

15a. User chooses to not save his/her answers and result.
1. System asks the user for confirmation.
2a. User confirms that no answers or result should be saved this time.
2b. User regrets the decision and chooses to save the answers and result anyway.
1. System saves the answers.

17a. User forgets to log out.
1. System saves the answers and result and logs out the user automatically after a certain period of inactivity.

17b. User wants to do the questions all over again and chooses to restart the questions.
1. System shows the first question together with the user's previous answers to that question.

Special Requirements:
- New users to Mentor should be able to create an account.
- System should have a function to provide new passwords in case of forgotten passwords.
- System should be self-instructing and so intuitive to use, so that no manual is needed.
- System terminology should be adequate for the teaching domain.
- System must be easy to use even for users without much experience of computers.
- It should be possible to choose several answers at the same time.
- There should be an inactivity timer preventing that the user leaves in the middle of running the application, possibly exposing the answers to others passing by the computer.

Technology and Data Variations List:
- Mentor should use hypermedia techniques, possibly web based.
- Result should be generated through knowledge-based techniques

Open Issues:
- Is an English version enough, or should Mentor support several languages?