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Reconciliation of Pedagogical Objectives, Technical Opportunities and Stereotypes of Educational Application: Case Perioperative Nursing

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Abstract: In the design of educational applications, expertise in several fields is needed: pedagogy, technology and interaction design, among others. Since the aim of an educational application is to promote learning, there should be a clear hierarchy in the perspectives: pedagogical objectives should be the primary perspective, while others play merely an instrumental role. However, it appears that pedagogy is rarely seen as a separate area of expertise. Learning is considered a mundane concept that most people understand. This setting may cause conflicts within a design group. In this paper we present a typical case study, in which pedagogical expertise was overlooked. The resulting application was primitive, in terms of actual learning objectives. Despite this pedagogical failure, the members of the group who were not experts in pedagogy, found the application appropriate for the intended educational use. In a concise user study, the participants were astonishingly satisfied as well. We conclude that the halo around computer technology is still so strong, that it easily overrides obvious flaws in design.

Introduction

Whenever new kinds of technology are introduced, someone is proposing to use it in education. Common to these proposals is that they are rarely initiated by educationalists; rather they are created and developed by, for example engineers or politicians. Personal digital devices, connected to the internet, for instance personal computers, tablets and smartphones, do not make an exception. Education is once again argued to undergo a revolution in the new media environment.

In the current study, we report a case, which concerns an apparently typical educational application project. This report analyses phenomena around these kinds of projects, striving to figure out the big picture, without being lured by the fancy appearance of all those fashionable gizmos. Rather, we try to take technology in the educational context purely as a means to achieve the educational objectives. Once all activities in the project are considered in terms of objectives, interesting issues arise.

In this paper, we first briefly describe the historical perspective of educational technologies in order to create a framework within which also current day technologies can be seen. We then describe the background, organisation and other essential issues of the case project. The development process of the case application is then described from the point-of-view of formal and hidden agendas (so called *hidden curriculum*, coined by Jackson, 1968). Further, observations are reported about an evaluation of the application prototype. This evaluation was mainly carried out to detect usability issues, but relevant observations were additionally made concerning pedagogical matters. The results of this usability evaluation support the argumentation relating the essence of the paper - discussion about the self-evident flaws of the process, outcome and their causes.

What is Educational Technology all about?

In his seminal book “Mindstorms: Children, computers, and powerful ideas” Seymour Papert (1980) pertinently discusses the difference between different educational technologies. Papert distinguished between traditional educational technologies (like blackboard and overhead projector) and computers. The crucial difference which he found was that traditional educational technologies have been created from the beginning as educational technology. There has been some educational need or problem, and technology has been designed as a solution. This kind of educational technology has been designed from scratch, purely in terms of education. In contrast, computers

were not initially designed for education. Personal computers were designed for offices. When computers were introduced in schools, they were declared, not designed, as educational technology. Therefore, we argue that many of the problems relating to the application of computational devices in education are fundamentally administrative in nature, rather than pedagogical.

Papert's idea of dividing educational technologies into those which have been designed in educational institutions, largely by educationalists, and those which have been imported from other contexts, is interesting from this historical point-of-view. Papert contrasted "traditional" educational technology with computers, but the same division holds for many other technologies as well. For instance, film, radio and video, were designed outside the educational context but only later were introduced as educational technology. Common to all of these – let us call them imported educational technologies – is that they have evoked overly optimistic expectations, and that they have gradually faded out of the educational scene (Reiser 2001, Selwyn 2011). It is too early of course, to apply this claim in the latest, currently used digital educational applications; only time will show whether e.g. tablet-based educational applications will follow a similar kind of life-cycle as their predecessors.

The advocates of modern technology are possibly convinced that finally, this generation of technology is the fulfilment of all the hopes and desires of those who introduced film, radio, television and microcomputers in schools. Similarly, the techno-sceptics see currently fashionable educational technologies just another soon-to-fade hype. There would be an endless list of arguments for and against this proposition.

A closely related, concept, technology acceptance, has been studied since the end of the 1980s. During the past 20 years, technology acceptance models have been applied to a variety of technologies both in organisational and non-organisational settings. According previous research, there are two perceived characteristics about a technology that is believed to predict the usage outcomes: perceived usefulness and perceived ease of use (Davis, 1989; Davis Bagozzi & Warshaw, 1989). Even though the importance of perceived usefulness has been proved by numerous studies, very little attention has been placed on investigating what it actually means for a system to be useful (Benbasat & Barki, 2007).

Usefulness of a product or a system can be divided into two parts; utility and usability. Utility means whether the product provides the features you need or not, whereas usability tells us how easy and pleasant these features are to use. Usability is a multi-dimensional property of a user interface including five usability attributes: learnability, efficiency, memorability, errors, and satisfaction (Nielsen, 1993, 24-26). User satisfaction or learnability etc. are however, no guarantee for the success of an educational application. If anything, the main requirements of the applications should be to meet the learning requirements and possibilities to enhance skills learning, in this case perioperative nursing skills.

In the current paper we do not speculate about the future of interactive technology in education. Instead, we reflect on our experiences regarding one case study in the history of instructional technology, and subsequently related conceptions of learning and teaching.

Case Project: Background and Assignment

The current study is produced within a multidisciplinary development project which had an assignment to produce a prototype of an educational game for the educational needs of perioperative nurse students and newly-graduated nurses.

The utilisation of games in nurse education has previously been proposed on the basis of changing requirements of nurse profession (Petit dit Dariel et al. 2013). On the other hand, games have been proposed as a way to make nurse education enjoyable (Baid & Lambert 2010). Stanley and Latimer (2011) conclude on the basis of literature review that many other advantages can be found in the use of educational games in nursing education. The listed advantages include motivation (fun, exiting, stimulating), association of theory and practice, social factors (creating community, enhancing interaction among leaners), meta-cognitive or learning skills (active learning, critical thinking abilities). Thus the starting point for the project was promising.

The development project group consisted of specialists from three large organisations: Teachers of nursing (University of Applied Sciences), education technology and usability researchers (University) and nurses working in the field (hospital), as well as other IT and management professionals. In addition, there was a project leader and responsible leaders of each participating organisation. The main realiser of the game construction was an independent IT software company which was selected based on an open bidding competition.

Due to the varying characteristics of the involved organisations, the project participants had various agendas and roles in the development group. The hospital participants were primarily interested in developing the orientation training for newcomer nurses working at the hospital. They were also seeking new efficient methods for

continuing education. The teachers of nursing education, who were the originators of the educational game idea, were seeking new teaching tools and practices – partly in response to societal change involving the hypothetical needs of the so-called information society, and partly as pure enthusiasm in developing their own pedagogical practices. Participating researchers were acting as consultants of education technology and usability, and their primary interest was to ensure that the prototype of the educational game to be developed would be suitable for the learning and teaching purposes intended. This task was executed by:

1) analysing the background and potential of different ways to utilise computer technology in education,
2) discovering the objectives of nursing education and making them explicit, and
3) finally evaluating the prototype and suggesting improvements.

A central research aim was to produce knowledge on real and formal learning objectives of perioperative nursing. At first a tentative set of learning objectives for perioperative nursing were gathered from various sources, such as formal curriculum documents. Thereafter, these tentative objectives were elaborated by two expert panels, each of which consisted of three experienced nursing teachers. Based on the results of this phase, researchers made suggestions on how to use these objectives as a foundation for an educational game and for the project execution.

The need to develop a proper educational game prototype was seen as a common aim amongst all of these participating organisations. A game prototype and the development process were, however, seen rather differently among the participants. Due to the various agendas of the development group participants, the practical realisation of the actual game was seen as the primary task of the project by the representatives of the hospital, as well as those of the nursing school. In both the hospital and nursing school the prototype was primarily conceptualised as a computer application, rather than a solution to some pedagogical problem or challenge. The goal was not to solve any problem in teaching, rather to look for different and new ways of implementing it. Moreover, the researchers saw the process of making a game prototype as an iterative cycle of testing and evaluating various ideas, resulting in selection of the best ones. These ideas could then be used in the implementation of a prototype or mock-up which would illustrate the game concept. The researchers found the creation of a framework involving innovative educational and gaming ideas, and later on, the meticulous requirements specification, as the main outcomes to strive for.

In addition to different agendas among project participants, there were also pressures concerning timetabling and usage of funding. Therefore, the game development had already begun before the completion of the research oriented background work. In other words, the technical implementation started before there was a clear vision about the aims. Also, some central decisions, such as programming language and the game platform had already been decided by the leading organisation, based on the recommendations of the software company, not on the study of learning objectives.

During the game development, the nursing teachers and student groups were acting as the main content providers. This task, however, proved very challenging, in spite of the previously defined learning objectives. Providing the content was heavily restricted by the technological limitations of the software. As a result, only certain types of interaction could be implemented, such as multiple choice questions. This gave the application a certain form of written multiple choice examination, even though videos and pictures were supported to provide variation to a sequence of simple questions with explicit right or wrong answers. For instance, the demo version which was tested and reported in the next sub-section, was a pure case of linear programmed learning: a succession of multiple choice questions. Correct answer led to a notice of right answer and to the next question. A wrong answer resulted in a notice of mistake and the application gave an opportunity to retry, except in so called “fatal errors”, which resulted in the termination of the game. At the end of game, the application showed the statistics about success. The demo version was for playing alone, but the game had a group mode, too.Figure 1 is a screenshot which shows a sample question with multiple answer choices.

There are several problems in using this kind of structure for learning purposes. It is overly ambitious to assume that the players would maintain a high level of motivation after playing a few times. The questions measuring only superficial learning or memory are hardly challenging. Problem-solving tasks which require reasoning and reflection and which do not necessarily have only one right or wrong answer would be much more practical within this learning context. Game-type learning always requires some kind of measurement of success or failure (the so-called internal point in Rowe 1992). It should also include some form of competition in order to be motivating and addictive for the player. It can be stated that the learning objectives of perioperative nursing skills are rarely issues used as a form of competition or measurement. Sometimes this matter and that of game playing operate in contradiction to each other.

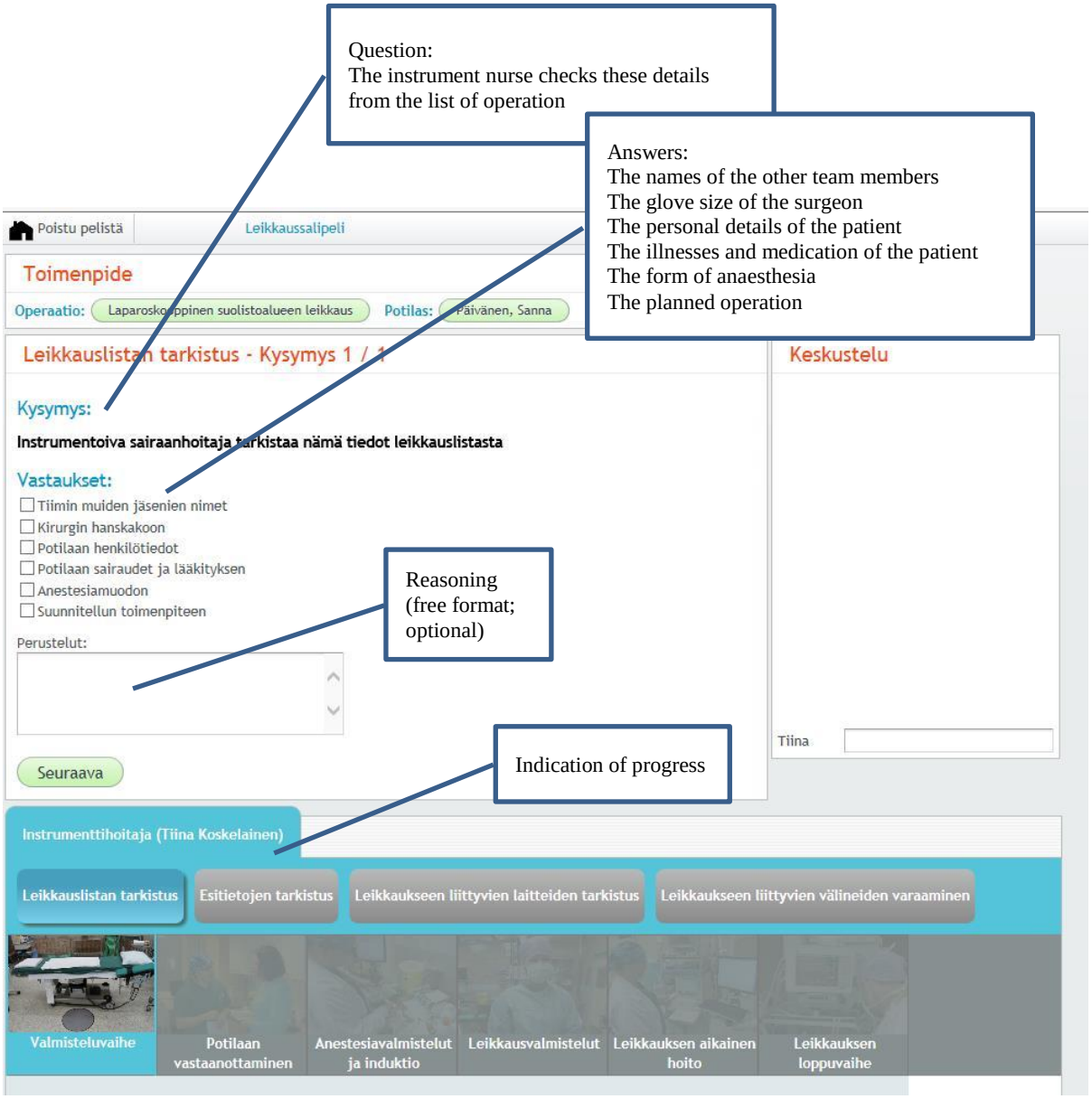

Figure 1. Screenshot of the application

Evaluation

The prototype of the educational application/game was tested by six student volunteers in December 2013 and January 2014. The focus of the evaluation was to gather information about usability and usefulness of the surgical application/game for the needs of prototype development. The data was gathered by two means: videorecording the test situation and interviews. Subjects were asked to think aloud while playing the game. Afterwards, the subjects were interviewed on the basis of several follow-up questions. The test situation was videorecorded. The subjects were 20-34 year old students from the University of Applied Sciences. They were not majoring in perioperative nursing. Because the subjects were not familiar with the terminology and practice of perioperative nursing, they were provided written answers to the questions. During the evaluation, they only

pretended that they knew the answers even if they merely copied the correct choices from this supplementary material.

All of the subjects performed the same operation with the same patient and in the same role (instrument nurse). After a short introduction the subjects started the game. They were encouraged to express their feelings about the game as well as describe what they were doing. Traditionally, the thinking-aloud method is a psychological research method. Nowadays it has been used increasingly for the practical evaluation of human-computer interfaces (Nielsen 1993, p. 195). According to Nielsen, the strength of this method is the wealth of qualitative data collected from a small number of users. In addition, the user's comments will make the test report more readable and memorable. One of the challenges of the thinking-aloud method is the fact, that thinking out loud seems to be unnatural to most people. (Nielsen 1993, p. 195)

After the data collection, both the videos and the interviews were transcribed. Observations from the videos of the usability trials and interviews were transcribed. Collected data was analysed as follows.

There were five female and one male subject in the prototype test. Four out of six subjects had little previous experience of using educational applications, such as applications for practicing English or other languages. All of the subjects had used information and communication technology, e.g. e-mail, portals, databases, and learning environments, regularly in their studies. Almost all were positive towards the use of technology while studying. Only one of the subjects preferred traditional ways of studying:

> ***"Yes, I'm afraid we have to use information and communication technology in studies. I don't like it, but I have to use it… I prefer attending lectures and writing down some notes." [E]***

Table 1 shows the main usability findings of the surgical game. Most of the subjects were so focused on the questions, that they did not pay any attention to the additional features of the game, e.g. video clip, conversation/messaging possibility, or images and phase sequence chart on the screen. At the beginning of the game half of the subjects faced problems with the user interface. They did not know how to proceed. Furthermore, all of the subjects who had to restart the game after a fatal error faced usability problems as well. They had major difficulties in finding their way back to the home page of the game. Even though the graphical user interface of the application and functional features got some negative feedback from the subjects, they found that in general the application was easy to use.

> ***"Well, it took me some time to find out how to proceed because there was so much stuff on the screen… but it is not a problem of course… I mean that it should not be too easy like some kind of children's game with only three buttons and nothing else… But overall, it was so easy to use…" [C]***

> ***"Well, it was quite simple when you get used to it. … I had some difficulties to see clearly because of the small font size, but…. The game was quite simple." [D]***

	A	B	C	D	E	F
Pays attention to the images or/and phases on the screen				✓	✓	
Does not notice the images and phases on the screen at all	✓					
Remembers to request the images or/and phases		✓	✓			✓
Pays attention to the video clip		✓			✓	
Pays attention to conversation/messaging possibility	✓	✓		✓	✓	
Finds the home page confusing	✓		✓	✓		
Restarts the game after facing fatal error			✓	✓		✓
Has difficulties in finding the way back to the home page when restarting the game after a fatal error			✓	✓		✓
Finds the game easy to use	✓	✓	✓	✓	✓	✓

Table 1. Main usability findings of the surgical game

One of the main points in designing this application was to show the process of surgical operation with a sequence of images and phases. In spite of that, most of the subjects did not pay attention to the illustration of the sequence at all. Only two out of six subjects paid attention to the images and phases during the game. Half of the subjects remembered something about those features when asked after testing:

> ***"Well, I don't remember anything"… [thinking]… "Well, there were at least some kinds of headings… about different phases… But, I did not pay attention to any other features…" [A]***
>
> ***"Well…. no, I did not pay any attention to that…" "Oh yes!... Now I remember… there were some images indeed, but I was so focused on those questions…" [C]***

The subjects highlighted the pedagogical means of using this kind of application for educational purposes noting that it should support learning and it should be used in combination with other pedagogical means at the appropriate point of the curriculum.

All of the subjects felt that the application would suit well for perioperative nurses' training and promote their learning as well:

> ***"This game/application fits just well for learning purposes." [D]***
>
> ***"Yes, I think that this kind of game/application suits quite well for educational purposes… If you think about a traditional exam… if it is well designed you will learn something from it. This is the same kind of situation… a learning situation… you can always learn something new." [A]***

These results were quite confusing because the application is very simple and learning is primarily based on memorising. In fact, one of the subjects described the game as a substitute for an examiner:

> ***"It will be a nice application to check your learning…. this kind of application helps people to study and…. it's like someone who asks questions about the subject matter." [C]***

In addition to supporting learning, one of the subjects pointed out that these kinds of educational applications would make learning nice and easy:

> ***"For learning support, yes… This will make studying more interesting and entertaining… You can learn without noticing it… Studying feels more fun, not hard work… This would suit for me at least." [F]***

Two thirds of the subjects proposed some improvements for the application. In addition to technical and visual improvements of the application, there were a couple of propositions for functional improvements. One of the propositions dealt with argumentation and another with feedback:

"I think that it would be good for learning if you have to argue for at least some of your answers… for example in yes/no questions… This kind of argument would promote your learning and give some ideas how your process of thought works. … Moreover, it would bring more content to the game." [E]

"There should have been some kind of feedback when your answer was not right… Such as who is responsible for these duties, or what is the right answer, or something like that…" [F]

On the whole, this application or game was found easy to use. Although the subjects pointed out that educational application should include argumentation and give feedback, they still found that this application would suit well for perioperative nurses' training.

Conclusions & Discussion

Looking from outside the application development project which has been described in this paper, we can perceive several interesting issues. As can be seen, there were a number of contradictions along the way. Contradictions are not a bad thing at all in creative work, but they should be handled in a constructive manner.

The fundamental contradiction was in the different orientations of different participants. The representatives of the University of Applied Sciences appeared to be very enthusiastic about digital technology – for them it was important to computerise teaching. For the company who implemented the application, this was just another application development project, in which the main challenges were technical in nature. The researchers were educationalists and usability consultants by background, so for them this was primarily a means to develop education and usability, as well as a research challenge. The duty of a researcher is to question phenomena that may generally be found self-evident. For instance, the phenomena relating to the so-called information society are generally taken for granted, something that is being developed organically, under natural laws. Yet, on the contrary, for a researcher the development of the information society is a highly societal activity; it is carried out by human beings who are also responsible for the consequences. Therefore, it is important to critically consider societal change, in this case the intended change in nursing education. The project participants from the University of Applied Sciences had very different kinds of priorities. They were committed to the development of an application, which could later be commercialised. For them, any questioning of the implementation was a more or less annoying obstruction in the construction of the application.

In other words, questioning was the main duty for one part, and an avoidable activity for the other. So there was a total contradiction in which diplomatic skills were valuable. However, there were more constraints than just this contradiction – the time-table related terms of the funding, as discussed above. Even if we started the project by defining the objectives in depth and by brainstorming innovative game ideas, these activities were not valued. Instead of new ideas, we were presented with a ready-made concept of an educational game. The explanation of this course of action was the need for speeding up the game development process in order to save limited time resources for programming work and to gain a more complete product by the end of the project. The concept was – from the educational point-of-view – a pure case of so-called programmed learning (or programmed instruction), which used to be in fashion several decades ago, when attempts were made to implement behaviouristic strategies in learning and instruction (see e.g. Skinner, 1985). In addition, the concept was representative of the simplest linear form of programmed learning: brief instruction, a multiple choice question, and immediate feedback (right/wrong). It was on this model that the implementation of our case application was finally based, except that so far there has not been instruction in any of the versions. All that was left was a web-based test consisting of a sequence of multiple choice questions.

The aim of the project, in terms of concrete application, was to construct an educational game. As can be seen in these descriptions, the result cannot be classified as computer assisted instruction, since it lacks instruction. In fact, it is very hard to see it as a learning application at all, except perhaps for the evaluating purposes of the

learning outcome. Another question relates to whether or not this is a game at all. The answer obviously depends on the definition of game – basically, defined on an extremely abstract level, almost any human interaction with the environment could be conceptualised as game. Taking a well-structured definition, however, is probably a more constructive policy. For instance, the widely referred to definition of Rowe (1992) analyses the concept and classifies several kinds of games. Common to these is, in Rowe's words, the *internal point*; that is, the fundamental aim or goal of the game. This and many other qualities that are commonly seen to make a human artefact such as a game, are totally missing in our case application. We thus argue that the application of our case study, which was supposed to be an educational game, is neither education nor a game.

The analysis above hints that the project was a more or less total failure. All the more interesting is that in the evaluation, the participants were very happy with the application. They found it not only easy to use, but also appropriate for education. How should we interpret this irrational satisfaction? First, it has to be remembered that the participants of the evaluation were not nursing students, so the contents was unfamiliar to them. It would therefore be tempting to argue that the positive feedback was simply because they had no expertise in perioperative nursing. It is equally obvious that our relatively young participants did not have prior experiences of programmed learning or other ancient instructional strategies. For them, this was something new and contemporary. If this is the explanation, we can only be amazed at how totally this digital technology has blinded us. Anything sells when it works in a gleaming tablet. According to the evaluation, it seems that studying with any kind of digital technology is more fun than studying by "traditional" means – which used to be called the *novelty effect* (Clark & Sugrue, 1988) in the era of the introduction of *multimedia* as the definitive solution for learning and teaching.

In this kind of development project it is also essential to define what usefulness and ease of use mean in relation to the targeted application. The use of educational technology itself does not lead to better learning outcomes. Is it enough if the application is enjoyable and easy to use? Or should we concentrate on pedagogical issues as well? Traditionally, the idea of technology acceptance studies has been to find reasons for why people do not accept or use computers at work. In our study, the situation is completely the opposite; we try to figure out why people accept the application which is not useful and does not support their learning.

We argue that the use of this application does not promote the learning of perioperative nursing skills, at least no better than by applying any other instructional method. It only gives the correct answers to the questions. There is no place for reflective thinking or argumentation during the game; you are just supposed to memorise all the right answers. This kind of studying resembles the way many traditional examinations are performed which might be a familiar way for the students to test their knowledge (thus being easy to adopt), but that is not the aim of instructional technology. Do we want that for example perioperative nursing students just memorize the right answers or do we want them really to learn their tasks and duties? Do we want them to automatise their behaviour by drilling, or do we want to coach them to be ready for the variable challenges and to be situationally sensitive and critically reflective in their work?

If we extrapolate the history of educational technology, it appears that within a few years, the hype around portable digital e-learning will fade out. When the hype is gone we are finally able to have a rational look at current day technology in education. This would be a very positive thing from the point-of-view of educational applications: we would be able to sort the wheat from the chaff. Hopefully we have learned a lesson from the current situation and are better prepared to face the next hype – and yes, there will be a new one behind the corner.

We end this report by presenting a set of principles, which we will follow in the future upon becoming involved in another educational application development project:

1) Educational objectives will be explicated in the beginning of the project.
2) Educational objectives will override all other objectives and agendas.
3) There is educational and usability expertise and experience in the development group.
4) The experts of education take the leading role in the decision making processes of the project.
5) Usability is acknowledged as an important issue in the development of learning applications.
6) The risks are acknowledged and failure is an option.

The last point (6) implies that we acknowledge that the construction of an educational application is a challenging project, in which you can never take success for granted. Only a critical evaluation of the outcome can validate a success.

Last, but not least, it has to be reminded that the educational applications that are just learning material at school, in other words chosen by a teacher, can be used in countless amounts of ways. For instance, we have recommended using the application presented in this paper as a framework for actual education: The students could author the contents, and while preparing the material, they would have to familiarise themselves with the content in depth. The actual game would thus be just out of curiosity, or a minor by-product of a process which promotes learning. In the near future, we are going to test this idea and how it works in practice.

In the preface of a section called *Programming teaching* in his edited volume *Readings in educational psychology: Learning and teaching* (1970) Edgar Stones wrote 45 years ago:

> ***The early vogue for programs based on the operant conditioning of verbal behaviour and emphasis on hardware is giving way to an open questioning approach which emphasizes the precise statement of objectives and the analysis of the teaching task from the logical and the psychological point of view. This approach de-emphasizes hardware and calls on machines only when essential to a specific teaching task.***

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