An Empirical Modelling Approach to Educational Technology in Learning about Business

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Abstract

Continuous change in technology and the awareness of a new approach for education led to a 'revolution in education' in the past. Educational Technology (ET) is the proposed solutions for these problems as a result of rethinking education. One implementation of ET is using Empirical Modelling (EM) techniques. Learning through interaction with the computer plays an important role in thinking about education. Therefore a business model is developed to illustrate the learning process.

1 Introduction

This paper briefly introduces learning in particular in respect to the school context and examines the historical change in educational concepts and technologies to show the development and importance of ET.

The next section illustrates how this approach can be supported by EM. Observation, dependency and agency as the main concepts of EM serve the idea of building models that can be investigated. Thinking of artefacts and their interaction with the learner leads to the construction of a concrete model. With reference to EM principles a business model has been developed to evaluate the quality of EM in this context and moreover to substantiate the urgency of ET.

Results from the modelling task will be discussed.

2 Introduction

2.1 Learning and Education

'Learning may be defined as the process of gaining knowledge, skills or experience. To be of benefit the learner should be able to apply his/her newly acquired assets in authentic situations' (Twinisles.dev 2003).

From the beginning of their lives children learn, understand and experience the world they live in. Education helps them from school age on to develop and improve their knowledge and abilities professionally. Looking into the past the implementation of educational techniques varied over time. 'Traditional education sees intelligence as inherent in the human mind and therefore in no need to of being learned. This would mean that it is proper for School to teach facts, ideas and values on the assumption that human beings (of any age) are endowed by nature with the ability to use them' (Papert, 1993, pp. 85).

This approach can be summarised as instructionism, i.e. learning depends on instructions. The better these instructions the more learning will improve. (Papert, 1993, pp.138)

In recent years the concept of constructivism[1] has become accepted and more and more applied (Jonassen, 1991). Through interaction with the environment individuals actively construct knowledge while making sense of the world and to get a deeper understanding. But if it is believed that learners purely receive information then the emphasis will be on instructions[2]. (von Glasersfeld, 1989).

Constructionism builds on these constructivist ideas and goes one step further. Knowledge is created when people are engaged in constructing 'personally-meaningful artefacts'. It is a time constraint definition that has to be continuously re-evaluated and reconstructed in the form of educational activities or tools. (Kafai & Resnick, 1996, p.1)

Changing perspective and becoming an active part of the education process leads learners to inspiration and to a sophisticated learning. Knowledge is not only gained from the specific topic but also from associated domains (Papert, 1993, pp. 97).

2.2 Historical Development

In the 1960s people began to think of methods how computers could support learning. A long time it was not possible to establish an educational computer culture. With the advent of the microcomputer in the mid 70s it started to spread over the minds of thousands and thousands. Although the theoretical

[1] Theories of Jean Piaget (Kafai & Resnick, 1996, p.1)
[2] Knowledge transmission

concept of constructionist ideas was prepared, finally there was the possibility of implementing them. (Papert, 1993, pp. 160)

In the beginning Educational Technology[3] in terms of computers in education was not properly used to serve the intended vision of a possible radical change in education. 'Increasingly, the computers of the very near future will be the private property of individuals, and this will gradually return to the individual the power to determine patterns of education'. In fact, a rampant number of people got involved in the idea of computers and education. (Papert, 1993, pp. 36)

Especially teachers were interested but furthermore there was big enthusiasm in the fields of research and business (Papert, 1993, pp. 160).

At the threshold of the information age[4] new learning techniques had to be applied. Indeed, there are a lot discussions going on in public. Concerns about how good learning can be achieved in such a dynamic environment are shown in the different established organisations[5] which see the importance of improvement in education and are therefore involved in these matters and proceedings (Kafai & Resnick, 1996, p.2).

Both the development of novel educational approaches and the rapid technological progress, i.e. hard- and software, point to a radical change in education (Kafai & Resnick, 1996, p.2).

2.3 Educational Technology

The more general approach of the new learning is called instructional technology (Molenda, 2003). Instructional technology can be understood as 'a complex, integrated process involving people, procedures, ideas, devices[6], and organization, for analyzing problems, and devising, implementing, evaluating and managing solutions to those problems, involved in all aspects of human learning' (Glossary), 'used to improve performance' (Encyclopedia of Educational Technology).

ET is instructional technology but applies only to the school context (Wikipedia), i.e. ET is only concerned with technology as it is related to the learning process (Educational Technology, 2006), and therefore represents a framework which has been developed to counter the historical development mentioned in 2.2.

Systematic processes are used to achieve educational and training goals (Bridgeport University). One of these processes is the ADDIE model that consists of different stages illustrated in Fig.1. The model is a 'dynamic, flexible guideline for building effective training and performance support tools' (Encyclopedia of Educational Technology).

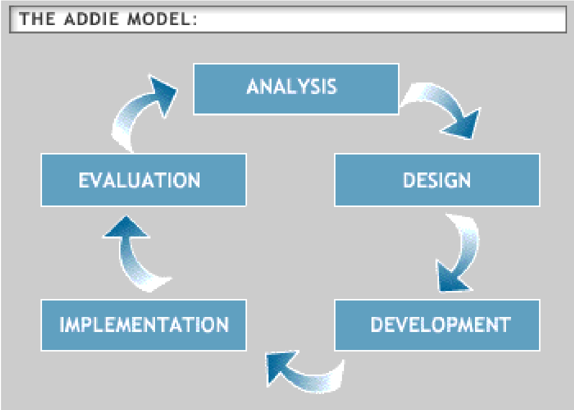

Fig. 1: ADDIE model

One characteristic of ET are educational[7] objects. They play an important role in order to encourage people to look into a subject of interest and letting them actively taking part in the learning process.

A definition of an object is given by the Learning Technology Standards Committee (LTSC): an object is 'any entity, digital or non-digital, which can be used, re-used or referenced during technology supported learning'. (IEEE LTSC, 2006).

With regard to learning objects which can be seen as artefacts EM is introduced to discuss the possibility for the support of ET.

3 Empirical Modelling

3.1 Empirical Modelling and Education

The approach of EM differs from conventional programming, or computer science. Differences can result from changing perspective, interpretation, experience and others. Observation, dependency and agency as the main concepts of EM serve the idea of building models that can be investigated, customized and played with.

Beynon (1997) points to an approach of computer-based modelling in education and emphasises

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[3] See 2.3

[4] In the last ten years the Internet, and particularly the World Wide Web, has become a platform where a nearly immeasurable amount of knowledge is available (mostly free of charge) to a tremendous number of individuals who can be located anywhere in the world. Limitations of education have started to become blurry (Twinisles.dev 2003).

[5] the IEEE Learning Technology Standards Committee (LTSC), the International Society for Technology in Education (ISTE) and the Association for Educational Communications and Technology (ACET)

[6] Although ET can also refer to analogue technologies like photographs, film, video, audio recordings etc. but of special interest is the computer technology (Educational Technology, 2006).

[7] They are also called knowledge or learning objects. These objects are differently interpreted in many ways (Friesen, 2001).

the link between concept and construction. Of course there are more applications possible like engineering design, artificial intelligence and human computing.

With focus on 'Education' in terms of EM and on 'Devices' (computers) in terms of ET Fig. 2 shows how they can be put to each other. EM and ET create some kind of matrix, i.e. either the horizontal bar can vary to use something else for 'Education' or the vertical bar can vary using 'Devices' for the other approaches of EM.

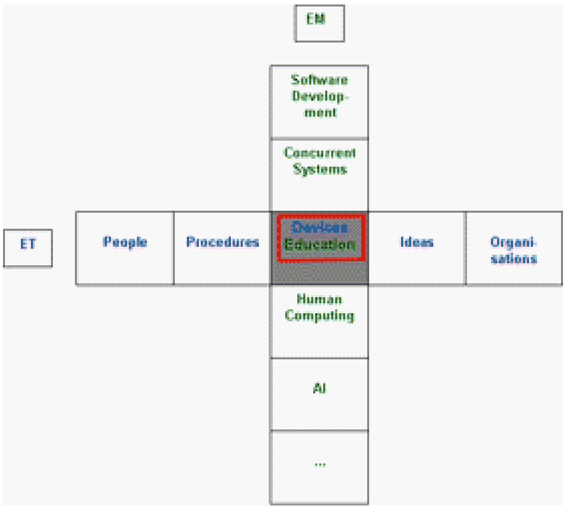

Fig. 2: EM and ET combined

Learning objects (see 2.3) are artefacts to be modelled. These artefacts that embody what is experienced are created to find an easy and reasonable access in order to support ET. With an understanding of EM principles the learner should be enabled to correctly interact with the model.

'Developing [an artefact] in EM is a voyage, of discovery, a creative activity that is quite unlike conventional programming, where the emphasis is on representing well-understood behaviours' (Beynon & Roe, 2006). It shows the justification using EM for active learning.

The learning process itself can be described in terms of the Experiential Framework for Learning (EFL) as elaborated on in (Roe, 2003) which goes back to William James (James, 1996). Private experience results in public experience and the other way round, i.e. informal knowledge becomes formal and vice versa.

3.2 Empirical Modelling and Technology in Education

There are problems identified in the infrastructure for education that address different perspectives as stated in Beynon (1997). Limitations of current technology can be summarised as follows:

- Developing system models in ways that allow flexible adaptation, extensions and reuse even by users who aren't computer specialists,
- Developing techniques that allow machine-independent specification of software,
- Creation of an artefact that exploit computer-based technology to liberate creativity,
- Supporting an open-development rather than a closed-world engineering culture.

In solving these problems with the help of EM there is a high potential to overcome present constraints to implement a new infrastructure for education.

4 The Business Model

4.1 Building the Model

The paper has given so far a theoretical background about ET. Nonetheless, maybe even more important is the practical part. The EM model that is introduced in this section has certain characteristics for learning which will be explained when the model is explored.

The purpose of the modelling study was to develop a tool to provide the learner with experienced knowledge about a very simple business process. Furthermore, ideas how to react in specific circumstances and demonstrating their effects should top the learning activity off.

The metaphor of a model experienced as an onion[8] and its different layers is a guide through the development process which starts very simple and becomes more and more sophisticated, i.e. the level of detail is increased and links between different layers has to be understood to pursue reasonably.

The model consists of four stages which will be discussed in more detail below.

4.2 Exploring the 'Onion'

4.2.1 Initial Stage – Customer and Market

The first stage is very constrained. Also, only a few elements are introduced. The experience that should be made is how the price of a product can be used to create or decrease demand. Completely neglected is the fact that in reality there is no one-dimensional influence factors on a product. For learning it is exactly the right way to start with. At this point it can

[8] See http://www.dcs.warwick.ac.uk/modelling/

be seen that this relationship is only one of many and that other functions can be applied according to the specific product.

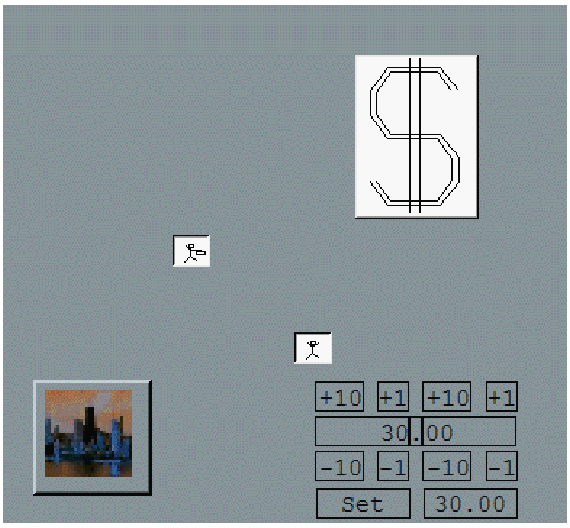

Fig. 3: Initial Stage

4.2.2 Second Stage - Factory

This experience leads directly to several questions that a learner could have in mind. For example, who is on the other side of this cycle? Where does the product come from so many or few people are interested in?

The amount that is manufactured and brought to the market enables the factory (owner) to measure gains, costs and profits. The relation to the initial stage in terms of experimenting to find one or more optima in running a business is examined.

Coming so far, this stage gives a very abstract picture of a market place and the possible surrounding parties.

4.2.3 Third Stage - Competitor

With the third stage the model becomes quite more complex. The factory (owner) is not the only one who produces and sells to the customers. A monopoly is often not realistic. Many are competing and fighting for the right to sell products. Primitive behaviour of the customers is established to make plausible that there are constraints and certain ranges where business can operate according to others.

The competitor has a fixed amount to produce and a fixed price for which he will receive money. Questions can arise what to do with this money or thinking more in general about the own situation. To make the model more interactive there is the possibility to input data for amount and price. With this feature not only the given example of price-amount-combination can be experienced.

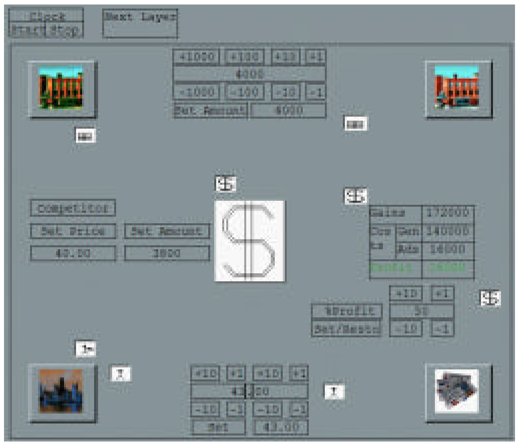

Fig 4: Last Stage

4.2.4 Last Stage - Advertisement

Finally the model introduces a sophisticated instrument to stimulate or even boost demand. The problem of the awareness of a product to the costumer is when he is arbitrary in choice from where he can get the things he needs. Although the emphasis is on the own product people compare to make the best of this situation. Customer behaviour will change, to which extent is a question of the modeller to which points he wants the learner to focus on. This is expressed in the model and should be discovered.

4.3 Further Development

The change of customer behaviour according to the advertisements was just initiated. The effects on the factory (owner) and the competitor are still missing but the idea behind it gives a hint where this model can be taken.

At every stage the learner should reflect his achievements and should also find out whether the topics addressed are of certain value to him. The stages explained in the paper build the first layers of the ‘onion’ but there is much more left. As explained above the interest determines granularity (the size of layers).

5 Conclusion

This model should apply to the school context. It can provide children (pupils) with basic insights about the business world. But this can only be the beginning.

The different stages in the model cover the topics mentioned earlier in this paper about the ET approach. Apart from other papers the intention here was not to present as much information as can be gathered to talk about a huge topic like this. In fact, main focus was to present the shift in mind and technology which initialised discussion about new approaches of learning resulting in Educational Technology.

Modellers push ‘constructionists’ ideas forward and enable learners to follow and adapt them.

Through the modelling exercise with EM it was possible to implement learning and educational ideas as these ‘personally-meaningful artefacts’ (Kafai & Resnick, 1996, p.1).

Remaining difficulties that are to be addressed in future are mentioned (Beynon, 1997). In solving the problems of tomorrow EM will probably be a matter of influence in the area of education and learning through technology.

The model itself is incomplete. The real potential of this application begins where the model ends. To see how the different elements are related to and influence each other is therefore open for improvement. The easiest way to do so is to exchange the underlying mathematical models and bring in more realistic terms. Another possibility would be to think of varies branches with its parameters and assumption in order to calculate price and amount.

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