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Use for learning or learn to use: A use scenario based approach to the design of educational applications

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Abstract. The design of an educational application is a complex process, with a wide variety of pedagogical and technological choices. Unlike in the planning of classroom teaching, it is usually a group task in nature that engages many people with different backgrounds and motivations. Hence, the whole design process requires effective means to communicate and understand the purpose of an application in its intended learning situation and to put together clear use-situation -derived design principles and priorities. In this article, we introduce a context-orientated design method, which makes implicit ideas about the use and the users of an educational application explicit. Rich Use Scenario is formulated in a story about a person or persons using an application. By determining authentic actions and thoughts taking place in the intended learning situation it provides means to immerse oneself in the procedure of using the application in its context. Moreover, the creating process of Rich Use Scenario necessitates a clear focus on fundamental meta-design aspects of an educational application and thus provides a convenient means to reflect design choices against any design-guiding conditions, for example pedagogical values, curriculum or practical suitability.

1. Introduction

The purpose of educational technology is to support education. Technology is a tool to make education better than it would have been without technology. However, what is 'better' or 'good' in education largely depends on who you are asking. Generally, in information systems design, procedures like task analysis and requirement analysis are important tools, which form the criterion for application development. However, concerning educational technology, educators (e.g., teachers) are often offered solutions which do not match the objectives or work practices in the educational context; it appears as if the background work in the form of, for example, requirement analysis has been neglected. This may be firstly because teaching and learning are often regarded as such everyday concepts that any application designer

can imagine what is needed. In other words, they do not necessarily acknowledge the need for educational expertise in the development process. Another reason is that education can be organised in endless ways, and each educator has his or her personal preferences. An educational application may not take into account this kind of diversity. As a result, teachers may have to conform their working practices to educational utilities: *learn to use* them instead of just *using* them *for learning*.

The design and implementation of educational applications usually take place in projects that involve group collaboration amongst people with various backgrounds. All the members of the group have their own motivations for their participation in the project and their own agendas concerning the outcome. In any professionally organised project, there are obviously formal goals, but these do not necessarily align with the personal ones. This setting is analogous with organised teaching; curriculum sets the official aims but then we talk about a hidden curriculum (coined by Jackson, 1968), which reflects the teacher's personal drivers. Unlike in the planning of classroom teaching, the design of educational applications as a group task requires the means to communicate within the group and to uncover any 'hidden curricula'. Therefore, explicit and commonly understood aims and principles of the design are important in order to guide and reflect design decisions during the whole development process.

2. Design perspectives on educational applications

This chapter focuses on a *context-based* perspective on the design of educational applications. Hence, we are exploring the basis for design methodology to facilitate the merging of technological solutions into an educational context. From this perspective, the emphasis is thus on the functional value of an educational application – or how seamlessly it can be used for learning – in its context of use. We chose to use the concept of *learning context ecology* as a perspective to cover the wide range of different formal and informal learning contexts and their various socio-cultural and physical *affordances* for teachers and students to participate. The continuing development of information and communication technologies (ICT) and the rapidly increasing usage of recent technological solutions in our culture further stress the importance of pragmatic design that connects with the actual use and target settings of future educational applications. This is especially important in constantly changing use contexts, which have recently been termed ubiquitous – education may be distributed everywhere.

Table 1. Three perspectives on the design of educational applications.

Context-based	*Substance-based*	*Application-based*
- **How technology can merge into the learning context**	- How the substance can be mediated via technology	- How the technology itself can be used in implementation
- **Functional value**	- Information value	- Artefact and engineering value
- **Learning-driven**	- Instruction-driven	- Technology-driven

In the process of application design, other than contextual views may easily become dominant. When designing educational material, content-orientated concerns about information and how it is organised for instruction are unavoidable. This *substance-based* perspective stresses the content of instruction[1], and how this substance should be mediated via technology. On the other hand, the design of a technically involved application naturally engages a mixture of engineering aspects regarding the actual implementation. This *application-based* design perspective thus concerns how and what technology is put into use. All these three perspectives (see Table 1) are relevant and important to the design of educational applications. But are they equally important? To prevent the situation where users and the ways of learning have to adapt to arbitrary design choices of an application, we propose hierarchical relations for these perspectives. No learning curriculum can be considered separately from its situatedness (Lave & Wenger 1991, pp. 97-98). Therefore, at the top of the hierarchy is the context-based level, which determines the requirements for the other two levels by defining the actual learning context ecology and by revealing the intended learning situation with its interactions. Only after that should it become possible to design suitable models for the substance and finally the actual technical model for implementation. But it is important to note that the issues of substance and technology are in fact concerned already on the context-based level because they are naturally a part of the learning context ecology and the actions that are afforded within.

To ensure the implementation in practice of a context-based approach, we particularly acknowledge the need for design methods that explicitly communicate any ideas and assumptions about the intended procedures involving the use of the application in its context. *Use scenarios* are widely utilised in the design of technological applications (see e.g., Carroll, 2000). The basic scheme of the use scenario is to create a credible description of the application usage, so that the ideas about implementation can be evaluated against it. The scheme is similar to the planning of classroom teaching, where a teacher can anticipate often very accurate and vivid scenarios about the upcoming classroom situations. In this article, we

[1] Substance-based emphasis in design may dangerously walk hand-in-hand with objectivist conceptualisations of learning by determining "the knowledge to be transferred".

propose the use of so-called Rich Use Scenario (RUS) as a tool for understanding the participants of a learning process when using an interactive application in order to achieve the educational goals. While use scenarios traditionally concern how representative the described situation or user character is, RUS – in contrast – is a vivid and immersive description of a specific use situation.

3. Changing roles of learner, teacher, technology, instruction, industry, administration and culture (society)

Education is a deeply rooted cultural institution. Both its forms and contents are tightly connected to prevailing values, political trends, and other societal phenomena. Therefore, even educational technology can never be separated from its cultural context. What educational technology is in the future is therefore highly dependent on the development of society as a whole.

In the educational framework, there are several stakeholders whose roles are changing along with the changes in society. Learner, teacher, technology and related industry, management and content, for instance, have different roles in different times. To be prepared for the future, this constant change has to be taken into account. For sure, academia will constantly produce new theories of learning, or at least elaborate the existing ones. Each government in democratic societies has their educational programmes, possibly reflecting a certain political ideology.

However, people who are responsible for the organisation of education, like teachers, need to do their job in all circumstances. Therefore, they do not need to be sensitive only to changes, but also need to acquire a 'bigger picture' which is not dependent on short term trends. Likewise, the design of educational technology should not be limited to one single conception of learning or political ambition. This is firstly because the 'form' and the 'content' of education can never be separated – if a certain design is based on a certain conception of learning, it is probably of little use beyond that conception. For instance, the teaching machines of the 50's were tailored for programmed learning, and could not be used for anything else. Thus, the provided educational technology worked as the herald of a certain educational philosophy. Second, supporting only one way of organising education is very expensive. When new ideas about education come up, the previous ones with all their educational applications are discarded.

When striving towards an educational technology which would not be too dependent on prevailing societal or cultural constraints, we should be able to formulate a sound basis for such versatile solutions. While many of the educational applications so far consciously build on certain conceptions of learning and teaching, we end up considering whether a versatile "meta" view of learning could be formulated. That would imply the bigger picture discussed above.

4. Description of a meta-view on the changing field of learning and instruction

While different conceptions of learning differ fundamentally from each other, is it even possible to find a definition of learning, teaching or knowledge, which could be accepted by all schools of learning theories? It could be argued, referring to Thomas Kuhn (1970), that different views of learning represent different scientific paradigms. Since the paradigm defines the concepts, and the whole perspective on the object of interest, theories within different paradigms can be seen as completely incommensurable. A strict interpretation of Kuhn would then make the comparison of different learning theories totally inappropriate.

Throughout human history, one of the central tasks of human beings has been to teach things to the next generation. Actually, this is one of the things which make us humans. There have always been great teachers, and argumentation about teaching practices. In organised education, like in schools, methods, environment, technology and most of the practices are relatively stable despite the changes in educational philosophy. We argue that this reflects the fact that there really is a set of widely agreed education-related conceptions. There is the official conception, which reflects the contemporary social setting. Then there is the unofficial one, which largely determines the practices. Concerning the content of education, this dualism can be seen in the contradiction of curriculum and the so-called hidden curriculum (Jackson, 1968, pp. 33-37) – the 'official' content and that which is implemented.

There have been earlier attempts to formulate a meta-view of learning conceptions. For instance, all analysis of conceptions of learning or the history of learning conceptions can be seen as attempts to express central concepts of learning from outside a certain school. The analysis of five approaches by Merriam and Caffarella (1999, p. 264) or the synthesis made by Ertmer and Newby (1993) are good examples. Ertmer and Newby classified three major schools of learning theory (behaviourism, cognitivism, constructivism) across two dimensions: *Level of learner's task knowledge* and *Level of cognitive processing required by the task* (Figure 1).

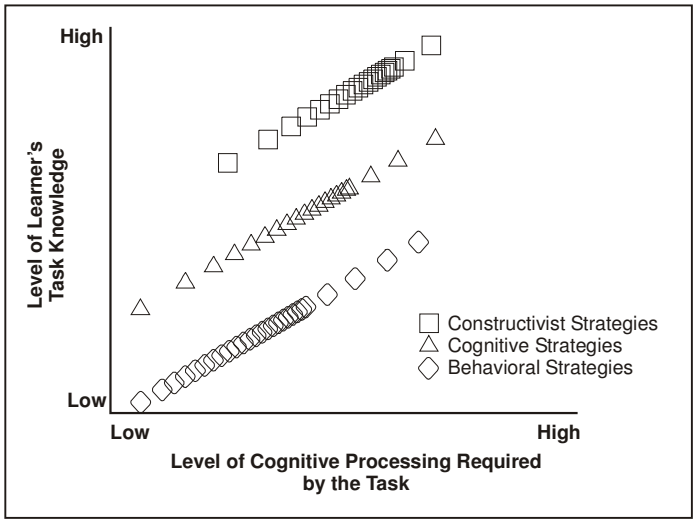

Figure 1. Comparison of different viewpoints on learning (Ertmer & Newby 1993).

Rather than interpreting different schools from inside a certain paradigm, these studies try to express the essence in colloquial language. The underlying idea is to choose an appropriate strategy for different learning tasks. In the development of educational philosophies the new ideas often strive to re-define learning, providing an all-encompassing, new learning paradigm. In contrast, Ertmer's and Newby's policy is to make pragmatic choices in terms of the educational objectives and the strengths of different strategies.

However, it can be argued again that these authors are tied to their own paradigm. They have their own conceptions, which are reflected in their interpretations. Therefore, these kinds of syntheses should be taken critically, but nevertheless, they have potential for enhancing understanding about the development of educational philosophy and the applicability of different strategies in different educational contexts.

5. Explicating a vision

In the design of educational technology of the future, the setting is analogous with the design of school buildings (which, broadly understood, can be seen as educational technology as well). The design of school buildings and classrooms is largely affected by the conceptions of learning and teaching. However, the building should be useful for a long period of time. During the life-cycle of the building, many new ideas emerge about how education should be organised. Also different teachers have different ideas, which may differ from the ideas of the designers of the building - not to mention the individual needs of the pupils and how these could be taken into account in this building. Apparently, it would be beneficial to have an *explicit vision* of what is really going to happen within the school. This kind of vision would provide the criteria for design ideas. Teachers, architects and constructors would thus have a shared idea of the functions and requirements of the building.

Educational technology, whether it is a question of 'low-tech' or 'high-tech', is based on the designers' vision of what education is, what kind of support it needs and, in particular, what learning and teaching mean in practice when using the application to be designed. The problem is that these conceptions do not necessarily match with the prevailing educational ideals (or philosophy). In other words, the designers' implicit idea of the use of the application does not support the kind of learning which the organiser of the education (e.g., teacher) is looking for. As a solution to this contradiction we propose the making of implicit visions clearly explicit. An interdisciplinary design team of an educational application inevitably requires expertise in both education and technology. The creation and use of this proposed explicit vision, a Rich Use Scenario, would concretise the educational reality, thus providing a basis for dialogue between experts in different areas.

In the design of educational applications, the RUS method has the potential for rising to the two challenges described above:

1) While the method makes implicit visions explicit, it uncovers the 'hidden curriculum'. Unlike in abstract, high level educational objectives, a concrete description of what is happening when the educational application is used provides a criterion for the design.

2) Concrete description of the use of the application can be used as a basis for reflecting it against various learning theories. The method thus explicates the learning paradigm followed.

In sum, RUS specifically highlights fundamental *meta-design* aspects of an educational application. As the creation of Rich Use Scenario should take place at the time of the conceptual design of an educational application, it affords the design team the opportunity to consider what kind of pedagogical and technological choices would best fit the intended purpose of application in its intended context. By describing actions experienced within the learning context, it enables the reflection of tentative design choices against any design-guiding principles, for example pedagogical values, curriculum or practical applicability.

6. Rich Use Scenario – the method and its use

Use scenarios are stories about people using an application (Carroll 2000). Their purpose is to reveal use issues which would otherwise have remained hidden. The traditional strategy in the preparation of use scenarios is to try to cover as many use cases and user types as possible. In practice, this has led to the need to formulate several use scenarios and to describe the characters in the stories in a fairly superficial manner.

The purpose of use scenarios in the RUS method, on the contrary, is not to be as generalisable as possible or cover all possible usages of an application. Instead, RUS concentrates on a qualitatively rich scenario instance that effectively reveals actions, interactions, contextual and mental issues involved in the use situation. A key

element of such a scenario is experience; hence the goal is to empathetically achieve situational immersion and (inner) re-enactment of a personage's experience. This has previously been found important in a design method which utilises so-called dramaturgical reading in the early stages of product design (Kantola, Tiitta, Mehto & Kankainen 2007)

The scenario is usually implemented in the form of a story which provides a plausible context, situational description and, most importantly, the *persona* through which the understanding of motivations, intentions and thinking behind actions is possible. So, the story allows the designers to immerse themselves in the life of the character, and in that way to understand her interactions with the environment. To enhance the situational experience, the implementation of the story may utilise various narration techniques, such as those used in radio-play dramaturgy.

RUS has previously been used in the design of user-interface sounds (e.g., Pirhonen, Murphy, McAllister, & Yu 2006; Pirhonen , Tuuri, Mustonen & Murphy 2007; Pirhonen & Tuuri 2009). However, the method would be applicable in an educational context as well. We now present RUS in the form in which it can be used in the design of an educational application.

The key elements of the RUS method are

1) the creation of a rich use scenario manuscript on the use of the application,
2) an arrangement of the scenario in the form of a narration, and
3) the planning and conducting of scenario enactment sessions.

Each of these stages will now be described in detail.

1. The creation of a rich use scenario manuscript In the RUS method, the design process starts by acknowledging the backlog of the application's general motivations, goals and the current ideas about conceptual design. By conceptualising this 'backlog knowledge' the design team can start to elaborate the description of the context of use of the application. Along with the development of the application's functional concept, the second phase in the creation of the manuscript thus concerns studying and brainstorming the schemes of plausible learning context ecology and types of interaction within. The objective is to achieve a shared understanding within a design group as a basis for the story writing. The creation of the actual story e.g., in the form of a radio play manuscript, means the articulation of the use scenario in a form that fulfils the requirements of that particular format (see next subsection).

A central element in this stage is to concurrently build up the *persona* through which the perspective for contextual situations is projected. The persona should thus provide a subjective view (from e.g., a teacher's or pupil's viewpoint) on the application use. Eventually, the persona should become "a common friend" for the design team.

We need to emphasise that, as a group task, the preparation of the manuscript and the story is an important part of the design itself. When the design team discusses the character and the events in the story, they reveal their attitudes and

conceptions about education and learning process. The final story should thus reflect the conceptions of the whole design team. This is the *meta-design* stage of the process. The purpose is not only to serve as a framework for the actual story writing, but also to explicate different views within the design team. The outcome of meta-design discussions is a list of the properties of the character and the events in the story (including the use of the functions of the application).

2. Arranging of narration. Manuscript in RUS means arrangement. On the basis of the manuscript, a written story or some other type of narration is being formed. This is a sensitive stage and would benefit from professional consultancy. For instance, expressing all the nuances of the manuscript in the form of a written story is far from straightforward; writing a prose format story, for instance, is not a trivial task since in RUS, the aim is an inspiring, thought provoking and immersive story. If a more appropriate form of narration is a radio play or a short film, expertise in that particular area is needed. The outcome of this stage is thus a story in one form or another. The format depends on what is needed in the next stage, in which the story plays a central role.

3. Planning and conducting of scenario enactment sessions. In what we call enactment sessions, the story forms a basis for exposing the initial ideas to the view of people from outside the actual design team. This third stage concerns the usage of the RUS outcome in the subsequent design phases of application development. It is not always required as the creation of rich use scenario itself may provide sufficient design guidance. Enactment usage may take a number of different forms. For example, when we used the method for the design of user-interface sounds, we put the story in the form of a radio play. Small volunteer groups then worked as brainstorming panels. In the beginning, the panellists were presented with a radio play. Radio-play has been prepared so that the interface sounds to be designed appear as "missing" sound effects. By immersing themselves in the narration, i.e. the character using the application, the task of the panellists was to imagine the missing sounds and brainstorm what kind of sound effects would fit those specific points of the story. The panellists were not sound designers; the underlying idea was to bring people with various backgrounds together to allow a fruitful mixture of perspectives, resulting in creative ideas.

In the design of consumer products, it is beneficial if the panellists represent different reference groups. However, when designing for a limited number of highly specialised professionals, the actual user group needs to have a final say. Therefore, in the latter case, we have used experts in the use context as panellists. For instance, when designing warning sounds for an anaesthesia workstation, we collected initial ideas from amateurs, but the sounds were then evaluated and elaborated by anaesthetists and nurse anaesthetists (Pirhonen & Tuuri 2009). The setting was largely analogous to the design of educational technology. We therefore recommend the use of both amateurs ("men-in-the-street") and professional educators when

brainstorming educational applications with the RUS method. Amateurs are able to see the situation from a distance, thus being able to provide creative, fresh ideas about the implementation of technology-aided education. Professionals, in turn, are obviously more aware of the constraints and opportunities in real life, and are competent in elaborating the ideas of the amateurs.

Even though the example above concerned user-interface sounds only, the radio play would be an appropriate form of narration in other kind of design tasks as well. It has been found that a radio play enables creative thinking much more effectively than, for example, a video format (Greenfield, Farrar & Beagless-Roos 1986, Greenfield & Beagless-Roos 1988). An important advantage of a radio play format over most other formats is that when used in group work, the attention of the whole group would be on the same issues at each point of time. In a video, each panellist would be able to focus their attention on different visual items. In a written story, the focused item depends on individual reading speed. Therefore, the radio play format has previously been applied when designing haptic feedback for a user-interface (Kuber, Yu & McAllister 2007), as well as proposed for use in the design of wearable technology (Pirhonen & Murphy 2008).

7. Concluding statements

In this chapter, a method called Rich Use Scenario has been presented as a common basis for an application development group. Ultimately, RUS enhances communication within a group, encouraging group members to discuss using common language and agreed aims. The method is proposed as a starting point for the development of an educational application in any educational context.

It will be hard or inappropriate to measure whether the use of RUS results in better applications. Rather than trying to convince readers that the method has proved to be effective in many contexts, we refer to the basic idea; RUS encourages developers to identify themselves with the characters in a story. The method can thus be argued to be extremely learner centred. Whether it works in a given context, should therefore be judged in terms of communication within the development group. Do the members to the group spontaneously justify their opinions and suggestions in terms of the character in the story?

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