Multimedia Interfaces for Educational Systems

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The development of increasingly powerful computer technology has led to an increased interest in the development of user-centred computer interfaces. A user-centred interface is expected to provide a high level of usability to the computer user. This usability can be supported by minimising the cognitive load of the user, supporting his/her individual cognitive style, providing supportiveness in terms of appropriate guidance through the interaction and making the user feel comfortable with the system. However, little attention has been paid to the fact that educational systems put more specific constraints on the interface and that the user of an educational system has particular characteristics that need to be accounted for.

This paper, therefore, investigates the factors of usability in the specific context of a learning interaction. It explores the possibilities of communication media and approaches used in current interface technologies and the way in which they can support the usability requirements of interfaces for learners. This paper concludes with the claim that the integration of different media into Multimedia interfaces is most suitable for educational systems since it best supports the manifold and demanding needs of a learner as a system user.

Keywords: Computer-user Interface, Multimedia, Educational Computing

1. Introduction

The design of computer-user interfaces has moved along with the accelerating progress in hardware. The users of the early digital computers had to be computer specialists in order to take advantage of these new machines. However, the speed of computation which these machines could offer was so useful for certain scientific disciplines that some scientists were prepared to acquire the skills required to use a computer (Shackel 1990). The first serious business computers were developed in the 1950s. These were still developed by computer specialists for use by data processing professionals. Only with the advent of the minicomputer and remote access to mainframes in the 1970s were computers beginning to be accessible for a wider group of lay users. The increase in power, together with the reduction of costs of computers, has promoted the emergence of a wide and diverse range of software applications.

Consequently, the issues of human-computer interaction became more apparent and critical and the attention to aspects of user interfacing increased (Shackel 1990). Although these aspects included factors such as costs and efficiency, human factor issues of usability gained increasing consideration and have led to the development of increasingly user-centred interfaces.

However, although user-centred interfaces have the reputation of increasing the usability of the computer for the average user, there are user groups and interactions that have more specific user interface requirements. One major user group of this kind are the users of educational software systems, i.e. learners. The requirements of learners go beyond the standard requirements for system usability. Interfaces that can support learning processes must not only be able to provide a tool for the efficient completion of a task, they also have to take account of the special requirements of a learning situation. These requirements may include the individual needs and characteristics of the learner, the nature of the subject to be learned and the learning approach used.

This paper determines the requirements for learner-centred interfaces, i.e. for interfaces that best

support a teaching interaction, in order to recommend the kind of user interface that is most suitable for educational systems.

For this purpose this paper first discusses the characteristics that determine a user-centred interface as a prerequisite on which the development of interfaces for educational software can be built. It continues to determine the specific characteristics and requirements of the learner as a system user and discusses its implications on the development of learner-centred interfaces. Finally, this paper makes recommendations on how current interface technologies may be able to support successful learner-centred interfacing leading to the claim that Multimedia interfaces best support the requirements of a teaching interaction and the learner that takes part in it.

2. User-centred Interfaces: Providing Good Usability for the User

The first jobs carried out by computers involved routine processing tasks such as bookkeeping where mechanical procedures could easily be taken over from men/women by the machine. Nowadays, computers are also commonly used for more interactive tasks such as word processing and financial simulation (Landauer 1990). The objective of developing interactive systems was to make people more productive (Waterworth 1992). This productivity is not necessarily always reflected in a reduction of time needed to complete a task. In fact, it has become apparent that the increasing capabilities of certain software applications have put greater demand on the quality of certain task outputs instead of reducing completion time. Word processors and desktop publishers, for example, have increased the standards expected from the documentation produced rather than simply reduced the time needed to create the document.

Still, the increasingly interactive use of computer systems has led to the demand for more user-centred interfaces that not only provide adequate functionality but also ease of use for the user, i.e. good usability (Cooper and Bowers 1995). The usability of a system can be defined in terms of how quickly and easily the system allows the user to carry out relevant tasks. It is, therefore, essential to understand and appreciate the intended users, and their goals and needs, in order to make the underlying concepts perceivable and comprehensible to the user (Barfield 1993, Hemard 1997).

Although it has generally been agreed that a high level of usability is essential for user-centred interfacing, usability remains a difficult to define and measure concept. However, the demand for a way to evaluate the usability of a user interface has resulted in a number of attempts to quantify the usability of a user interface. Although there are no established guidelines on what constitutes a completely user-centred interface, a number of factors that determine the usability of a system have been identified. These factors represent constraints which have to be considered within the design of the user interface in such a way that the usability of the system is maximised. The factors can be grouped under the headings of *cognitive load and style, supportiveness* and *acceptability* (Angelides and Tong 1995b, Waterworth 1992, Smith 1997). The remainder of this section discusses these factors in turn, in order to establish a framework that can be used as a basis for an investigation of the more specific requirements of a learner as a system user. The factors of usability will, therefore, be revisited in section 3 in the context of learner requirements.

2.1. Cognitive Load and Style

It is the task of the interface to compensate for any cognitive insufficiencies of the user. Rather than having to infer or guess the effects of his/her actions the effects should be a visible part of the interface. There are a number of related factors that may help to reduce the cognitive load of the user. These include *consistency, abstraction, fidelity and flexibility* as explained below.

An efficient user interface is generally expected to provide consistency in the way information is displayed to the user within the same and different applications. A consistent interface will always use the same conventions for displaying information and for interacting with the system across a range of similar situations.

A further factor is the level of abstraction of the real world at which the material is presented to

the user. Determining the right level of abstraction, i.e. what parts of the real world should be modelled and which should be omitted, is crucial and has to be determined according to the requirements of the user, the task, the system and the context.

Whilst the level of abstraction refers to the choice of what should be represented, the *fidelity* of the user interface refers to how well the presentation of the abstracted features match the real world (Angelides and Tong 1995b). We can distinguish between different kinds of fidelity: physical fidelity (feels the same), display fidelity (looks the same), mechanistic fidelity (behaves in the same way), conceptual fidelity (is thought of as the same) and expert fidelity (how the user's methods to carry out a task correspond with the methods used by the domain expert).

Finally, *flexibility* refers to the ability of the user interface to allow for alternative forms of interaction, e.g. for different kinds of users such as novices and experts. Whilst the experienced user, for example, might find the flexibility of using shortcuts a useful tool to increase efficiency, a less experienced user might find too many alternative ways to complete the same action rather confusing.

Consistency, the level of abstraction, fidelity and flexibility are factors of display and interaction style that need to be determined according to the requirements of the system's user. An aspect that is closely related to these issues is the aspect of learnability. An efficient user interface should ensure that the knowledge and skills required to interact with the user interface should be quick and easy to learn and, preferably, transferable between applications.

2.2. Supportiveness

Supportiveness refers to the ability of the system to provide the right level of feedback or help to the user in order for the user to feel comfortable with the interface. It is desirable to ensure that the user is given the initiative over the interaction as far as possible. Leaving the initiative to the user requires the system to monitor the actions of the user and intervene when required, i.e. to control the user's actions to a sensible degree.

Whilst the provision of appropriate feedback on the user's action ensures that the user knows what the consequences of his/her actions are, the provision of help ensures that the user feels comfortable with the user interface, knowing that in case of an error the system will rescue the user by providing advice on how to correct the error.

Furthermore, leaving the initiative to the user requires the interface to impose some form of a structure on the activities the user engages in. A good structure allows the user to explore the ideas and concepts within the environment and the system to intervene when required.

2.3. Acceptability

Acceptability refers to the ability of the system to ensure that the user is satisfied with the system he/she is using. The interface has to operate within acceptable levels of human cost in terms of tiredness, discomfort, frustration and personal effort. A further issue to be considered is user motivation. The satisfaction offered by the interface should cause continued and enhanced usage of the system (Shackel 1990). The issue of acceptability is closely related to the remaining issues of usability.

3. Interfaces for Educational Systems

A user-centred interface must ensure that tasks can be carried out efficiently. It must compensate for the user's cognitive abilities, be supportive and provide user satisfaction. Pursuing these goals requires certain knowledge about the characteristics of the user and may vary according to the context in which the interaction with the computer is taking place. Over the past years the advance of technology has allowed us to develop user interfaces which provide satisfactory usability by advancing the realisation of the usability factors discussed in the previous section in current user interfaces. For the field of educational software, in particular, this recent advance in the development of user-centred interfaces has been crucial. At a time where the computer is becoming an increasingly popular teaching tool the user interface has to go beyond supporting the execution of a task towards supporting a learning process, i.e. the context of

teaching may impose special requirements that turn the user-centred interface into a learner-centred interface (Soloway and Pryor 1996).

It is apparent that the demand for the provision and support of learning capabilities in specific educational software packages is motivated by the desire to account for a particular kind of user, i.e. the learner. This desire imposes additional challenges on the usability of the user interface. Learners have unique needs beyond those of a traditional (professional) user.

3.1. The Learner as System User

As discussed in the introduction, the usability of a system can be defined in terms of how easily the system allows the user to carry out a task within a particular context. The context in which educational systems are used differs from the context in which other software is used. This difference is determined by the nature of the needs of the learner-user. The student is dealing with unfamiliar material and the objective of the interaction is to learn something rather than to do something. Whilst individuals in a profession share a significant degree of homogeneity, there is a high degree of heterogeneity between learners. For example, there is a wide range of different cognitive, social and cultural backgrounds and different learning styles in the average classroom.

Although efficiency has been recognised as a major factor that determines a good user interface, it is difficult to define what makes an interface to an educational system efficient. Although it is still desirable for the interface to ensure that the user can acquire knowledge quickly with minimum effort, there are further issues of efficiency which have to be balanced against the learning time needed. The retention of the learned material, for example, might be more crucial than the time needed to acquire the knowledge. However, little is known about the factors that increase the retention time and reduce learning time other than that learning appears to be most successful if it adapts to the needs and preferences of the student (Waterworth 1992).

Therefore, the development of a learner-centred interface requires the analysis of the learner and his/her particular learning requirements. Although the process of defining a comprehensive profile of a system user in general, or the learner in particular, seems to be an endless exercise (Hemard 1997), this section presents the main characteristics and requirements of the learner as a system user in order to review them in the light of the factors of usability discussed in the previous section.

The typical learner changes (or is expected to change) from novice, or advanced, to expert whilst he/she goes through the learning process. Further requirements of the user address issues, such as for what purpose the learner wants to learn, which learning strategy he/she prefers, when and where he/she wants to learn (Watts 1997). Within this context two issues gain in importance: Learners tend to follow different cognitive structures and need to be motivated.

Therefore, the learner-centred interface has to account for the factors of usability discussed in the previous section with respect to the special characteristics and needs of the learner. The remainder of this section reviews the factors of usability and makes suggestions on how they can accommodate the needs of the learner in order to establish guidelines for the development of learner-centred interfaces.

3.2. Cognitive Load and Style and Learning

In regard to cognitive load and style the learner-centred interface has to play a double role. Firstly, it is crucial to keep the cognitive load to a minimum in order to ensure that the learner can concentrate entirely on the learning process without having to remember how to use the interface. Secondly, the interface has to support the cognitive abilities and styles of the learner.

Cognitive Load and Learning

Keeping the cognitive load of the learner to a minimum is particularly important, since the learner does not have a sound understanding of the material he/she works with. Therefore, consistency in how the interaction is taking place has to be maintained in order to ensure that the student does not need to waste time and effort on learning how to use the interface itself. For the novice learner, in particular, it is crucial to remain consistent in the display of material (Waterworth 1992).

Similarly, the level of abstraction at which the learning material is displayed may depend on the aptitude level of the learner. A more advanced learner, for example, may require a more detailed presentation of a physical experiment than a novice learner.

Fidelity is often required to be high when the tutoring process involves the simulation of a real world physical object. If, for example, the tutoring process needs to provide the learner with what appears to be a realistic situation in which an exercise is carried out or in which a real world device needs to be operated, a high level of fidelity is required.

Cognitive Style and Learning: The Use of Teaching Strategies

A factor of usability that needs to be considered in the context of the support of cognitive style within a learning interaction is the factor of flexibility. The flexibility of a system was introduced in section 2 as the ability of the user interface to allow for alternative forms of interaction. The flexibility of a learning interaction may be reflected in the ability of the interface to support different teaching styles within different teaching situations and for different learners.

Cognitive psychologists have discovered that students go through different conceptual stages when learning a subject (Silverman 1992). Learning is not just a matter of simple knowledge transfer from machine to learner but a process of reconceptualisation, of getting the learner to construct the appropriate knowledge out of the knowledge he/she already posesses. It is important to take the learner through a progression and not merely teach him/her the expert's notion of knowledge (Angelides and Tong 1995a).

Students generally require different approaches at varying levels of aptitude. Also, a particular teaching style might prove to be more successful for a particular student purely on the basis of preference of the student (Silverman 1992).

In order to provide this kind of learning the teaching processes have to accommodate different teaching strategies for different teaching situations. Teaching strategies are used to present material. They depend on the subject matter and the instructional objectives of a teaching interaction. A teaching strategy determines the style of material delivery that is employed in order to lead the learner through the tutorial and to indicate the times at which intervention is required. The most common teaching strategies are explained below (Elsom-Cook 1991).

- Cognitive Apprenticeship. This strategy is based on the idea that cognitive skills can be learned in the same way as an apprentice in the crafts learns, i.e. by watching an expert in action and asking questions. The apprentice starts with the performance of small separate tasks which are gradually increased in size or linked to other tasks.
- Successive Refinement. This strategy is based on the principle that the material to be taught should be explained to the student in steps with gradually increasing levels of detail.
- Practice. The student is presented with a problem on the screen and is asked to carry out a task.
- Demonstration. The student is presented with an example-demonstration (Alpert et al 1995).
- Socratic Hinting. Socratic hinting attempts to place the user in a specific frame of mind (Silverman 1992). For this purpose the system provides the student with short reminders or questions which force him/her to reason about what he/she does and does not know.
- Analogue Reasoning. Analogue reasoning is a teaching strategy that may be used to present the student with a situation that portrays a problem from a different viewpoint.

The interface should ideally support a selection of different teaching strategies. The strategy is generally selected according to the peculiarities of a tutorial situation, such as the student's needs and preferences, his/her experience and the domain of discourse. However, whether a particular teaching strategy is applicable within a certain teaching situation might also be determined by the degree of structure of the subject area being taught. Teaching strategies need to be applied within subject areas ranging from structured to unstructured (Silverman 1992). A strategy such as successive refinement, for example, tends to be suitable for more structured problems. Here a detailed diagnostic result might be available to provide the details required to provide step-by-step refinement. Yet, a strategy such as analogue reasoning is more

frequently applicable within less structured domains.

It has become apparent that the consideration for consistency, the level of abstraction and the fidelity of a user interface with respect to the learner-user may certainly improve the time and effort required to learn and remember how to interact with the computer. In this way the learner can concentrate on the learning material rather than having to acquire 'interfacing skills' first. A further important requirement for a learner-centred interface is the need for high level of flexibility in regard to the teaching strategies the system has to offer for the different cognitive requirements of the learner and for the subject learnt.

3.3. Supportiveness and Learning

The early computer-assisted learning systems can be described as automated presentation devices for teaching material. They were built based on the theory of education that views learning as a process in which knowledge is communicated from teacher to student. Within this conventional view the teacher has control over what is taught and how (Elsom-Cook 1991). However, within a more popular theory of education knowledge is now viewed as a negotiable commodity between teacher and student and not as a given body of facts and theories. Accordingly, learning cannot simply be viewed as a process in which the teacher acts as a knowledge provider and the student as the recipient of this knowledge. Within this educational theory greater credence is given to the student's ability to regulate his/her own learning process. Here learning is based on a dialogue between student and teacher in which the student is given control over what the content to be learned can be, as well as control over his/her access to and experience of the content. The student constructs his/her own conception of the issues to be learned and it is the task of the teacher to facilitate the student's development of his/her own perspective of these issues (Beruvides and Koelling 1994, Laurillard 1991).

It is therefore the task of the user interface to support the implementation of such student control and, at the same time, provide the right level of guidance that is required to guarantee efficient and individualised tutoring. This guidance includes the provision of remedial tutoring and is particularly important in the context of learning since the learner is prone to making errors within the process of learning. For successful teaching to take place an educational system has to be able to cope with any student errors that may occur during a tutoring interaction. Remedial tutoring is increasingly viewed as a central part of the overall tutoring process and recent research calls for adaptive remedial support (Siemer and Angelides 1998). The kind of remedial help that might be appropriate may depend on the aptitude level of the learner and the context in which the help is required (Cooper and Bowers 1995).

3.4. Acceptability and Learning

A critical issue of acceptability, to be considered within the context of learning, is the factor of motivation. A high level of motivation is known to contribute towards successful learning. Also, often learners need extra motivation. Whilst professionals will try their best to get their job done, learners are often less accommodating. Interfaces, therefore, have to support the encouragement and engagement of the learner (Shneiderman 1992).

4. Existing Interface Technologies

The types of presentation currently used within user interfaces can be classified into graphics, text and sound (Barfield 1993). These forms of presentation can be used within a second-person or first-person interface. The basic idea of *first-person or direct-manipulation interfaces* is the visibility of objects and actions of interest on the screen. The user can carry out desired actions by manipulating objects on the screen. Within a *second-person interface* the user interacts with the system by giving a command to a computerised intermediary which then carries out the desired action (Angelides and Tong 1995b). In order to determine the potential of these two kinds of interfaces to provide usability this section explores the interaction styles they offer to support system usability.

4.1. First-person Interfaces and Usability

A first-person interface provides the user with the feeling of working directly with the system (O'Malley 1990). It is generally the graphical interaction style that is used in order to allow users direct interaction with graphical or iconic representations of underlying data or processes. In this way the student feels as if he/she is working directly with the domain. The interface becomes transparent and no longer exists for the student. The represented world becomes cognitively directly present. Direct manipulation allows users to carry out desired actions by manipulating objects.

First-person interfaces tend to be graphical rather than text-based and require the use of a pointing device to manipulate graphical objects on the screen. An example of a system using a direct manipulation interface is STEAMER, a simulation environment that teaches the functioning of steam plants (Hollan et al 1984).

The major advantage of this graphical interaction style is that it is intuitive due to its self-evidence. A detailed explanation of its use should not be required and consistency can easily be maintained by using the same representation for the same actions in different applications like the use of icons in the windows environment (Smith 1997). A graphical interaction style offers a flexible environment in which material can be displayed at varying levels of abstraction. Also, it provides a high level of display, mechanistic and conceptual fidelity. In this way it can help to reduce the cognitive load of the learner by providing him/her with an environment in which he/she can visualise the processes he/she intends to carry out.

The need for the provision of different teaching styles is also well supported by graphical representations. The nature of teaching strategies, for example, often implies the need for graphical presentation. Teaching strategies such as demonstration, practice and cognitive apprenticeship, for example, often involve activities that should resemble tasks from the real world. The use of interactive video, in particular, supports simulations and examples that may be used as part of a demonstration. The user can interact with the system and interrupt or choose his/her own sequence of the video (Collins et al 1997).

A demand put upon the user interface for the learner in respect to supportiveness is the ability of the interface to support an interaction in which the student is given control over the interaction with the system. Within a direct manipulation interface the learner has control over the way the learning material is manipulated. The learner can construct his/her own conception of the issues to be learned.

Remedial intervention that may be necessary may require the presentation of material in different formats. Depending on the type of the error or the situation in which the error may have occurred, the most suitable format may be a graphical presentation.

First-person interfaces can contribute towards the acceptability of a system by making the interaction more motivating for the user. Graphical and vocal presentation have proven to be more motivating than textual presentations. Videos, in particular, are known to catch the attention of the learner.

4.2. Second-person Interfaces and Usability

With second-person interfaces users interact with the domain by giving commands to a computerised intermediary which then carries out the desired actions. Second-person interfaces can be categorised into three major groups. The first group of interfaces uses *command languages*, the second category displays *menus* from which the student may choose an option and the third approach is *natural language interfaces*.

Command Languages

Command languages generally put a high demand on the memory load of the user. They take a long time to learn and then need to be used on a regular basis to be remembered. As a consequence command language interfaces are not very commonly used in educational systems. Still, command languages provide a very high level of control for the experienced user. The database query language SQL, for example, still remains the major database query language (Smith 1997). Also, command languages in itself represent a cognitive style which may be preferred by more advanced learners.

Menus

Menus display a list of options to the user who selects the desired option. Early interfaces employed the structured use of menus in which the user was supposed to choose from a number of options by typing in a number or character. The more recent pull-down menus are an extension of the structured menus providing the learner with a facility to look ahead along the possible sequences of action prior to committing to that choice. The use of menus is easy to learn and reduces the cognitive load of the learner. It can provide support through structured navigation for the novice learner. At the same time it can provide more advanced learners with a relatively fast way of interaction.

Menu-based systems stand between direct manipulation and second-person interfaces: being presented with information and selecting some of this information is a characteristic of second-person interfaces, whereas the direct way in which the user can specify the information is a characteristic of direct manipulation interfaces.

Natural Language Interfaces

The use of natural language is a popular interaction style for educational systems. SCHOLAR (Carbonell 1970), WHY (Stevens and Collins 1977) and GUIDON (Clancey 1987), for example, all apply some form of natural language interfacing. The student can communicate in a language he/she already knows with an agent that interprets his/her requests for any action to be carried out. There are two possible ways in which natural language interaction can be implemented, i.e. through written (displayed) text or through voice. Although voice input and output systems are still in their infancy, their development is advancing and their potential has been recognised.

Natural language interfaces can minimise the cognitive load of the learner since communication can take place in a format the learner is familiar with and does not require specific training.

Supportiveness in form of learner guidance is difficult to achieve by a natural language interface, because of the difficult task of the system to understand the behaviour of the user and to determine the support or guidance required.

The acceptability of a natural language interaction is generally high, because the user feels familiar with the interaction style. However, the level of acceptability is closely related to the degree to which the interface can communicate using natural language. An interface that attempts to cover a wide range of natural language often leads to frustration of the user, and the advantages of natural language may get lost if the user finds that handling the implemented natural language requires as much effort as learning a formal language. Partial solutions for specific application areas are therefore often suggested to reduce the danger of user frustration and disappointment (Krause 1993).

5. Towards Increased Usability of Educational Systems through Multimedia Interfaces

The previous section has shown that the range of currently common interaction styles which are based on single media can all make some individual contribution towards better interfaces for learning. The apparent contribution of graphics, video, text and sound towards improved usability for educational systems makes the merge of all the media supporting the various interactive styles into a Multimedia interface a desirable step towards more learner-centred interfaces (Goodman 1993).

5.1. Multimedia Interfacing and Cognitive Load and Style

The desire to keep the cognitive load of a learner to a minimum can well be supported by a Multimedia interface. The graphical representation and direct manipulation of both still pictures and video can increase the degree of fidelity of the material to be learnt (Goodman 1993). The learner can directly relate to a realistic representation of the learning material. Similarly, graphical presentation presents a good tool for abstraction. Details or components that may be confusing for the novice learner can be omitted, whilst a detailed video may be preferable for the more advanced learner.

The idea of combining different media in form of simulations, in particular, increases the fidelity of the interface. A Multimedia interface

can offer a safe and relatively inexpensive environment for risk taking, experimentation, exploration and problem solving (Collins et al 1997).

The 'Forces and Effects' physics learning package, for example, uses a multimedia interface in which the learner can carry out experiments that are either unsafe or impossible to carry out in the classroom. By manipulating still and moving icons on the screen the learner can work out velocities, accelerations, momentum etc. for moving objects such as cars or balls (Collins et al 1997).

Multimedia also has the advantage that it allows for the presentation of different views and structures, thereby offering support for different cognitive styles. Learning styles may be visually, aurally or tactilely oriented (Davis et al 1994), and a selection of different presentation media is useful when different types of teaching strategies are needed for different types of learners (Waterworth 1992). Whilst the strategy of Socratic Hinting, for example, may be supported by textual dialogue a demonstration may best be supported by video.

Finally, simultaneous use of different media supports the use of more than one human sense at the same time. During the display of a video, for example, the learner may be listening to an explanation of the things and actions he/she can see.

The Chemistry Set, for example, uses a mix of media to teach students about the elements of the periodic table. It can present photos of elements and compounds and models of molecules, it produces sounds made by different chemical reactions, it displays video clips of the reactions, text and tabulated data (Collins et al 1997).

The Explanation Planner (Woolf and Hall 1995) which teaches basic electricity and electrical networks consults the student about his/her preferred choice of presentation of the teaching material. The system provides the student with a choice of alternative presentations allowing him/her to change between graphics, text and animation.

5.2. Multimedia Interfacing and Supportiveness

One requirement for a learner-centred interface is the ability to leave the student in control of the learning process. At the same time sufficient guidance has to be provided so that the learner is free to explore without failing to achieve his/her learning goal. The degree to which learners require different levels of guidance may vary with the aptitude level of the learner. Multimedia user interfaces can provide guidance at different levels.

Textual representations such as menus, for example, may offer a number of restricted options to the learner. The number of options can be adapted according to the abilities of the learner (Oren
1990). The learner still has to take the initiative of moving through the learning process. However, some guidance is offered by the system through information hiding.

Similarly, Multimedia can support the need for a less structured learning environment in which the user may take greater control over his/her learning process. This can be achieved through the ability of multimedia to support non-linear presentation of the teaching material (Oren 1990) thereby providing a tool for exploratory learning. This kind of learning environment permits the learner to navigate through the learning process in a non-sequential way thereby offering increased freedom and control of the student over the learning process.

A teaching interaction generally requires the system to support the remediation of student errors that may occur. Multimedia can support the provision of adaptive remediation through the use of different forms of feedback (Barfield 1993).

5.3. Multimedia Interfacing and Acceptance

One of the main virtues of the use of multimedia is its enormous capacity to motivate the learner (Silverman 1992). Learners enjoy using an interactive multimedia environment. This increased involvement is caused by the 'audio-visual stimulus' and the 'active nature of the involvement' (Collins et al 1997). The Motion system, for example, allows learners to analyse the movement of objects which involve forces such as a car crash or the movement of a tennis or golf ball. Younger learners in particular have

been found to watch and listen to a moving sequence just for the sheer enjoyment of seeing the stresses and strains involved when using the Motion system (Collins et al 1997).

Also, the use of sound and text in form of natural language support acceptability since even the novice learner is immediately familiar with the form of communication used.

6. Conclusion

With the development of increasingly powerful computer technology the interest in the development of more user-centred computer interfaces has gained increasing attention. A user-centred interface is expected to provide a high level of usability to the computer user. Computer usability can be supported by minimising the cognitive load of the user, supporting his/her individual cognitive style, providing supportiveness in terms of appropriate freedom and guidance through the interaction and making the user feel comfortable with the system.

This paper has investigated the factors of usability in the specific context of a learning interaction. It has then discussed the possibilities of communication media and approaches used in current interface technologies and the way in which they can support the usability requirements of learner-centred interfaces. Based on this discussion the integration of different media into Multimedia interfaces is proposed as the best way to incorporate the virtues of different communication media into an interface that can support the manifold and demanding needs of a teaching interaction.

Multimedia interfaces can best support learner-usability. They succeed to reduce the cognitive load of the learner and support the provision of different teaching strategies. The integration of different media also offers opportunities for the learner to take different levels of control over the learning process and provides a learning environment in which the learner is more likely to be motivated.

In addition to supporting the implementation of the usability factors for educational systems, there are additional benefits multimedia has shown to provide for learners. Apart from supporting the intended teaching process, for example, Multimedia has the ability to stimulate a wide range of skills or talents in learners, including linguistic, musical, spatial and interpersonal abilities (Jenkins 1990). Also, Multimedia can widen a learner's experiences by giving him/her access to activities which would be impossible or time consuming to organise otherwise.

Still, there is a danger that the mere implementation of Multimedia for interfaces of educational systems is viewed as a guarantee for learner-centred interaction. However, the tremendous variety and flexibility offered within Multimedia interaction requires careful planning and adaptation to individual teaching situations and the learner involved and is still dependent on the difficult task of the system to understand the behaviour of the user and to determine the support and guidance required. In order to work towards the successful implementation of learner-centred Multimedia interfaces it is therefore essential that the recognition of the possibilities of Multimedia interfaces coincides with further research in learning behaviours and learner diagnosis techniques in order to get maximum benefit from the enormous potential Multimedia has to offer.

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