COUNT ON ME

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1. Introduction, background and objectives of the 'Count on Me' Project

'Count on Me' is a multimedia program for learning mathematics. It is being developed for first-year vocational education students. The Percentages Module is the first prototype for a series of ten multimedia (mathematics) modules. When complete, the series will form a first-year upper secondary vocational education course for students who want to refresh their arithmetic skills and knowledge of mathematics and/or who want to work on specific gaps in their knowledge.

Based on the principles of Realistic Mathematics Education, the subject matter covered in the modules builds on the main themes of the secondary school mathematics curriculum with an emphasis on arithmetic skills. The difficulty level lies between KSE (Education Qualification Structure) attainment targets 3 and 4. The program has a reflective character and, in addition to upper secondary vocational education curricula, can also be used in teacher and in-service training programs.

The module was designed in such a way that users should largely be able to work with it independently, assisted by the built-in adaptive tutor. Amongst other things, this means that the module contains all the relevant information about how the program works and how it can be used. A detailed handbook is therefore superfluous. Teachers cannot access any other overviews of the results than those available to the students. There is no separate program for teachers. The idea behind this was to make it possible for the program to be used, for example, in adult learning centres as well as in regular upper secondary vocational education (mathematics) curricula. For these reasons, the contents of this 'manual' are rather limited. Before working with the completed series of modules, the users will do a test. The results of this test can help them to decide which modules they want to do. Each module will have a final test that users can do at any given time.

2. Structure, contents and functionality of the 'Percentages' prototype

The module contains a database of contexts, sums, comments, explanation, tools, etc. and a tutor that provides assistance in navigating/working through the program.

The structure and contents of the database

The heart of the database consists of 400 percentages sums that are arranged in exercises or units, which follow a specific subject typology. The main principle behind this is that once a user manages to do a certain type of sums correctly, he or she will move on to a higher level.

The units are ordered in four chapters:
- mental arithmetic (with percentages)
- estimating (with percentages)
- using a calculator (with percentages)
- percentages at work (percentages in engineering, economics and social work)

The last chapter is different to the preceding three in that it deals with practical applications of the previously covered subject matter in engineering, economics and social work.

Each chapter (apart from the last one) contains:
- A short introductory video, which presents the problems of that chapter in a realistic context.
- (Video) explanations of the different facets of each particular subject.
- Sums – arranged in exercises/units that follow a specific typology. Sums from each exercise/unit are selected by the program at random and then read out. This can be infinitely repeated by clicking on the 'cassette tape' button. As the sum is read out, a short version of the text (i.e. not identical to the audio text) appears on the screen together with an appropriate photo or drawing. Each sum can be tried twice. Feedback is provided after each answer. This feedback is of a general nature, unless a particular incorrect answer is part of a so-called 'error category' (an error that has a systematic character, a 'typical' error). In that case, specific feedback is given.
- Three interactive thinking and arithmetic models – the ratio table, percentages strip and percentages table. Each model is accompanied by a hint – the reasoning/arithmetic method that should be generally employed when using a particular model – which can be called up (clicked on) separately. The ratio table should, for example, be used for thinking and reasoning with proportions (2% as 2 out of 100 or 1 out of 50). The percentages strip and the percentages table should be used for thinking and reasoning with fractions
    (2% as 2/100 or 1/50).
Special attention is given to introducing and learning how to work with these models. The models have two functions. They support the method of first reasoning by working with a 'piece of scribbling-paper' and when the pairs of numbers entered by the user in the models are compared for consistency, they make it possible to check the answer. This makes the models 'semi-transparent'.

For doing calculations with percentages on the worksheets, an on-screen calculator is available.

As a prelude to the first chapter, the program also contains:

• A log-on screen, where the user enters his/her (unique) PIN code. The program uses the PIN code to recognise the individual user and navigate him/her straight to the point where he/she worked at the previous session (see navigation).

• A preliminary test, which makes sure the user has sufficient knowledge of arithmetic to be able to start the module. In other words, the test assesses whether the user has the required foreknowledge to be able to work with percentages – e.g. comprehension of numbers, basic knowledge of ratios, being able to work with a calculator. etc.

• A short video that portrays the wide range of use of percentages arithmetic in daily life. The video helps to motivate the users and activate their foreknowledge. It deals with the three segments of the program – mental arithmetic, estimating and using a calculator.

The program is concluded with a final test, which the user can use to check whether he/she has sufficient grasp of the subject. The user can do this test at his/her discretion at any point in the program.

Navigation with the adaptive tutor

The user can call on the assistance of a built-in adaptive tutor, which works with the user's scores in the exercises to navigate him/her through the program. Navigation with the tutor is based on the 'rules' summarised below:

• After having done a sum (entered the answer), users can proceed to a higher level, go back to a lower level or do a similar sum (if applicable, the same one – two attempts are allowed for each sum). The option selected by the tutor depends on the user's answer and his/her scores for the preceding sums.

• The degree of progress when navigating ahead, can vary (this is comparable to omitting exercises in a textbook) and is greater if the user does a sum correctly straight away.

• Returning to a lower level depends on the user's performance when working through the different subjects in the program. Returning to a lower level can mean going back to an explanatory text or set of instructions, to doing easier sums, to another unit or subject etc.

At any time, the user can break off the tutor navigation and decide where he/she wants to go to in the program (the principle of mixed control). This is done by activating the main menu in the tool bar. The menu provides the user with an overview of the whole module and shows where he/she is currently working. The user can then select the point where he/she wants to go. The tutor will then further navigate the user from this point onwards applying the aforementioned 'rules'. If it goes 'wrong', the tutor will navigate the user back to the point in the program where he/she stopped working. The tutor also gives aural encouragement in the form of comments and accompanying remarks at the start and close of each (new) subject/unit in the program. The aural encouragement varies according to the user's performance at any given moment. At any time, the user can access information about the program and the help function with the menu bar.

3. Discussion

The general question raised by this type of program is: To what extent and in which way can and should educational software take over the instruction tasks of the teacher?
Fundamentally, the didactic functions of the learning process have an instructive and an educational component. The educational component involves coaching the learning process through motivating, encouraging and evaluating students. The instructive component includes functions such as determining the starting level, activating foreknowledge, teaching, explanation, making source material accessible, learning to learn, reflection, testing.

An ideal educational program should optimise the teacher's pedagogical and didactic functions. Attaining this ideal was the starting point in developing this program. However, we should not focus on what is technically possible, but on what is desirable for optimum control of the students' learning process and actual independent educational development in a 'learning to learn' environment.

The main problem in designing educational software can be formulated in three questions.

• Which learning functions do we **wish** to automate and from which educational viewpoint?
• Which instruction and education functions **can** be automated (how 'intelligent' should the program be)?
• How can the interaction between courseware and student be made as natural as possible using a multimedia interface? This applies to controlling/coaching the learning process, navigation and evaluating the students.

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