The Mass Use of ICT Demands Changes to the Entire Educational System

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1.Introduction

Demands on the standard of education are increasing in practically every field of human activity. This relates not merely to the knowledge and skills in one's own field essential to the further career growth of each individual, but also to knowledge of subjects relatively distant from one's own specialisation. This is the result of the overall demands on the cultural and social standard at a particular level of employment and social position. The clear consequence of this is the necessity for lifelong education which is an essential precondition to the ability to adapt to economic and technological changes and the ability to discover and implement innovative processes and thereby preserve one's competitiveness over the long term in a globalised world.

The fundamental precondition to success is mastery of information and communication technology (ICT), in other words the ability to take the greatest possible advantage of available modern computer technology. This must logically be reflected in the modernisation of the content and form of teaching. Certain signals indicate that this is happening with greater success at lower levels of the educational system than at secondary schools and universities. Easy access to public databases and the seemingly almost unlimited possibilities offered by browsers of an increasingly high standard are, however, accompanied by far from insignificant dangers. Students and teachers alike often forget the necessary checks on the limits to the usability of the operations (calculations) offered, which frequently leads to a fundamental distortion of the results obtained.

Today, even small children at nursery school learn how to work with various types of personal computer. Modern mobile telephones provide a direct Internet connection that offers access to practically all global database sources. This has its advantages and certain disadvantages. In childhood, this generally means various types of games, though an almost unlimited amount of information is available for the more inquisitive. As a consequence of a shortage of expert guidance, however, the child often picks up inappropriate habits, which prove difficult to get rid of later. These new technologies can, however, be generally said to have a clearly positive influence.

The situation in primary school teaching is more complicated. Primary schools have, since time immemorial, been said to have three basic tasks – to teach children reading, writing and arithmetic. The need for the teaching of these three basic skills has, however, changed with the increasing use of personal computers, intelligent calculators, notebooks and other similar aids. Take, for example, arithmetic. The majority of pupils now have problems with multiplication, division and single-figure numbers. Some even have problems with adding and subtracting without the use of a calculator.

Handwritten texts often border on the illegible, to say nothing of basic grammatical rules. In this respect, Czech is said to be a language with many peculiarities and exceptions, though similar problems are also encountered by our colleagues in other languages. The culture of the written text has been devastated by various mutilations, abbreviations and idioms (particularly popular in English texts).

The educational process at secondary schools understandably makes these problems even worse. The logarithmic tables that used to be indispensable have been replaced by algorithms built into even the cheapest calculators. There would, of course, be nothing damaging about this if this change were not accompanied by the absence of an awareness of the basic meaning, definition and possible uses of logarithmic functions.

There is also a social aspect to be considered here. The question of whether to allow the use of modern (at the time) pocket calculators was much discussed at technical universities in America in the nineteen seventies. Teachers at a number of schools pointed to possible discrimination against students from poorer families that could not afford to buy models with a wide range of pre-programmed functions (HP35, HP45 and later HP95) that were still relatively expensive. Some schools resolved this problem by banning the use of these devices during examinations, while others bought dozens of calculators of the same model that students could borrow for a limited period of time from the reception in the given building or the secretary of the institution. I think that this is no longer a serious problem today, as the price of simple notebooks and similar computing devices is no longer a limiting factor.

A number of things I have realised while teaching at a technical university (work I have been doing for more than 50 years now) have, however, given me reason for serious thought. These problems are largely associated with extremely frequent tasks in the areas of modelling, simulation, visualisation, projecting and digitalisation. Bachelor and master degree students use widely available algorithms, procedures and methods that are available as standard as toolboxes or subroutines in programme packages such as Matlab, Simulink, Simula, etc. They use them, however, without knowing the principles of the given methods of calculation, their limitations, or the necessary conditions under which the given programme provides the right answer. A theoretical description is generally contained in "help", though the majority of students do not, of course, read this. As a result, these students are often incapable of judging (or checking) the reality or correctness of the results supplied by the computer. A situation often arises in which students submit the results of their term examination or diploma that are evidently incorrect to the first expert glance. They then defend their work with the words "that's how it came out of the computer".

The verification of output products (such as new methods proposed for resolving familiar tasks, specific results of technological processes, or designs for objects and buildings) is a chapter in itself. The checks used generally take the form of widely known methods of simulation and modelling with the necessary attention being devoted to analysis of whether the model corresponds to reality or not. Such problems are particularly common in technical work, though there is certainly no shortage of them in sociology, biology and other sciences.
The observations given above can be summarised in a number of short recommendations of principles that should be observed in the future at various levels of education.

2. Conclusions

1. Insist on pupils having basic knowledge and skills at primary and secondary school. This relates, first and foremost, to the ability to formulate one's ideas comprehensibly in both oral and written form, observe the rules of spelling, and handle basic arithmetical operations.
2. Concentrate, during teaching at secondary school, on contexts rather than on specific data and formalistic axioms.
3. Pay attention to formally and methodically correct use of ICT tools.
4. Take into account the necessity of knowing the essence of the methods and technologies used in the system of university teaching, particularly in the natural sciences, to ensure the ability of checking and verifying results obtained using other means or approaches (one's own simple judgement often suffices).
5. Expand the range and increase the quality of educational activities within the system of lifelong education. This task may best be performed by universities and institutes of higher education with a professional focus.