Information and Communication Technologies as a Tool for Improving Teaching in Multigrade Schools

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1. Introduction: Multigrade schools in the Aegean islands

The Aegean islands are specific cases of social and economic development. Situated in the central and south part of the Aegean Archipelago, they face geographical isolation. They are at a distance from the mainland and from each other. Many of them are small, with low population density and most of them face serious communication problems. In almost all of them one can find strong work ethics, environmental quality and high community spirit.

In such communities, the school plays a vital role. If it stops operating, the island' s youth has to search for education elsewhere; if it leaves, it is uncertain whether it will ever return to stay in its birth-place. Under such circumstances, the school's operation becomes an important factor for the island's sustainable survival [4].

The small size of the relevant parameters in relation to the need for the continuation of operation of the school in these areas makes multigrade teaching still a realistic approach for schooling, persisting to provide education of acceptable standards at the beginning of the 21st century [1], [2].

Multigrade teaching occurs within a graded system of education when a single class contains two or more student grade levels. They can be found in great numbers in the developing world and in relatively small numbers in the remote areas of the developed countries due to scarcity of pupils, teachers and/or resources. In the 1960s and 1970s, "open education" and individualized instruction became influential curriculum and instructional models. Such models were commonly implemented with multigrade classrooms [3]. Multigrade schools are referred to variously in the literature as "multilevel", "multiple class", "composite class", "vertical group", "combined class", "one-teacher schools", and "unitary schools" [2].

In Greece, multigrade schools (found in small islands and remote mountainous villages) are small with a low number of pupils and include up to six grades in a classroom. The teacher works on the basis of the approved curriculum for each class, and during the time that she/he teaches one grade, occupies the rest of the children in other activities. If possible, some class activities may be conducted with children of more than one grade. In general the philosophy of multigrade schools is based on optimisation of personnel and time. This optimisation makes the operation of multigrade schools the only viable solution in the cases of remote and isolated areas.

In spite of such an important role, multigrade schools are very difficult to operate. Multigrade school teachers, who many times are young and inexperienced, have to meet the educational needs of different grades and this means multiple efforts. They do not have other colleagues to exchange views and to give solutions to pedagogical or administrative problems since most likely are isolated.

The pupils also feel isolated. The school is not for them the simulation of a challenging, competitive society. They do not have the opportunity to be influenced by many teachers and there is a feeling of getting less education from these schools that are different from the "normal" ones.

Yet from experimental studies assessing academic achievement in single grade and multigrade classrooms it was found that there is not significant difference between them. The data clearly support the multigrade classroom as a viable and equally effective organisation alternative to single grade instruction [3].

2. Information technology in multigrade schools

The introduction of Information Technology (IT) in any field of social and economic life promises revolutionary changes. These are of specific importance for small, remote and geographically isolated areas. Provided that some basic infrastructure and a minimum experience are available, IT offers anyone equal accessibility to information, irrespective of the size of the place one lives, the geographical characteristics and the distance from the centre.

Education could not be exception to such a technological development. IT provides tools that help the school's operation; it is a new instrument that makes teaching more effective and more stimulating; and through some specific applications, such as distance learning, it brings a complete reform to the learning process.

While important for any school, IT promises an increase in the quality of knowledge acquisition in multigrade schools. Through proper organization and support, multigrade schools can benefit from IT, becoming more efficient and competent.

The ways by which this is done have been examined in a pilot program whose task was to introduce IT applications to schools of the Aegean, containing a relatively large percentage of multigrade schools. This program named SXEDIA (in Greek means raft) and involves the installation of computers in 44 schools in 32 islands of the Aegean Sea [5]. It also involves the connection of the schools to the Internet, teacher training, work with educational software, development of web pages to represent the schools and help them communicate and distance learning from the University of the Aegean in Rhodes. The kind of schools involved are given in Table 1 below:

Table 1

Schools	No of Schools	Average pupils per teacher
1-grade*	10	8.3
2-grade	11	10.8
3-grade	9	9.2
4-grade	1	8.0
6-grade	13	11.6

* It means that the only teacher could have to teach up to six grades in a classroom!

3. Information Technology applications in the SXEDIA multigrade schools

In Greek multigrade schools, a teacher can choose to apply one of the following teaching methods:

- Holding activities
- Staggered start

According to the former, the teacher starts by teaching pupils of one grade. Meanwhile, the rest of the children are occupied with simple and enjoyable tasks that do not need the teacher's direct involvement. When teaching is completed, the pupils of that grade interchange places with pupils of another grade and the teacher starts teaching the new grade in the same way.

According to the latter, the teacher begins by teaching the pupils of one grade, motivating participation in some self- learning activities. Then, while the first group's pupils are busy working in such activities, the teacher begins working with another group. In this way, in one hour, the teacher activates in parallel more than one grade. It should be noted that it helps if the topics taught in parallel to different grades are from the same subject, but this is not necessary.

Holding Activities and Staggered Start have many common characteristics and can be considered equally efficient. Due to syllabi restrictions, other techniques, such as Differentiated Direct Teaching, are not applied.

Availability of IT infrastructure in multigrade schools and familiarity of teachers and pupils in the use of computers offer a unique opportunity for improving quality of multigrade teaching methods. Computers, in their role as educational instruments, favour time sharing between different groups of pupils,

promote self learning activities and help controlling the degree of teacher- pupil contact. Consequently they offer a means for upgrading parallel session teaching methods and for providing high educational standards.

Given the time table requirements, the teaching methodology limitations and the electronic equipment available, there are three major facilities by which IT may improve efficiency in multigrade schools:

- Conventional IT applications included to a standard personal computer system.
- Educational software.
- Internet and communication programs.

4. Conventional IT applications included to the computer (usually MS Office suite)

One of the popular activities in primary schools is that the teacher prepares and provides to the pupils specific educational material, adapted to each grade's average efficiency standards. This material usually contains:

- Exercises on a subject taught which the pupils are asked to answer.
- Motivation for learning or practicing on a specific subject (e.g. drawing).

While important for any school, such an educational material is highly valuable specifically for multigrade schools. Here this material becomes the basic means that helps occupying pupils of one grade while the teacher is working with another grade.

However, it is easily understood that for a teacher of a multigrade school, a well prepared educational material of this kind, is time consuming and tedious and requires multiple effort compared to the effort required by a teacher in a monograde school.

The solution was to compile and make electronically available a database containing the relevant work produced by many teachers. These teachers offered willingly their activities written in paper and these became the input for the database. By adopting a simple method for the organization and classification of this material (using criteria such as the instructive unit, the grade and the degree of difficulty) this database became an easily handled instrument that helps the teacher to make the choice that fits each grade's needs. The exercises can be printed photocopied and handed to pupils to work on. Alternatively, it is possible for the pupils to give the answer to the exercises electronically, practicing their skills in Word Processors, electronic drawing or simple calculations in a Spreadsheet.

The database, created in this way, and its application for occupying constructively pupils, proved to be a useful educational tool for teachers of multigrade schools. It is simple, easily accessible and requires only basic computer literacy. Since it contains products of teachers' work, it is tested in practice and it is adapted to meet the every day educational needs. The teacher can modify and alter anything on each text.

This area is subject to further development: The existing database is enriched continuously.

Also presentation programs are planned offering techniques that help the pupils to work on their own, to make revisions, to consolidate and finally to better understand a lesson. The need for such presentation programs is essential if one keeps in mind that the teacher in a multigrade school spends a limited time with each subject and cannot give the appropriate attention to each pupil. Moreover such programs promote the individualization of the curriculum, giving motives to the children to learn in their own pace, something that seems vital in the modern teaching methodology. This brings the discussion to the next step.

5. Educational software

In multigrade schools, the major problem of occupying some groups of children while the teacher works with one grade, can be confronted partially using commercially available educational software. This proves to be a good solution that can be applied with both teaching methods of multigrade schools. It assumes the existence of a library consisting of carefully selected educational software that covers almost all the subjects taught to an elementary school.

The process of occupying children with educational software is the following:

While the teacher is working with one grade, children of other grades are asked to study a specific topic using educational software (usually in the form of CDs). The pupils may be asked either to be ready to answer some questions, or to present a written essay on the topic.

The main difference between this application and the one mentioned in previous paragraph is that the educational software usually not only contains more information on a subject (and not only some specific points and questions related to it), but also the presentation framework mentioned above and facilities as marking, timing etc.

Through the program SXEDIA the schools were provided with a set of CDs that cover a wide range of general or specific topics (such as encyclopaedias, Greek, English, mathematics, tutorials on the subjects of each grade's curriculum, educational games etc). The CDs are carefully selected on the basis of some criteria among which the most important are:

- Easiness of usage and navigation.
- Good presentation of the content.
- Close relationship of the contents to the curriculum approved by the Ministry of Education and Pedagogical Institute.

The wide variety of the existing educational software in the form of CDs facilitates the creation of a relevant library but imposes the need for the evaluation of the quality of the software. In the case of SXEDIA, the difficulties faced in this context were due to:

- The fact that a large number of "good" educational software is not available in Greek.
- The material in the CDs was not always in accordance to the formal curriculum of each grade.
- In many cases there were no explicit information on the structure of the contents and the teacher had difficulties in knowing which part of the CD could be addressed to each grade. The supporting team at the University undertook the task of presenting it the web site this supplementary information.

In the case of the SXEDIA such educational material was used to cover subjects that otherwise would not be taught at all. Thus, in some multigrade schools, there was no teaching of English, arts or music from a specialist. The CD library gave the children the chance to get some elementary knowledge on these subjects, in their spare time, with limited instructions from their teacher.

Working with the above software, peer tutoring was a frequent phenomenon: pupils with more knowledge and older pupils served as "teachers" to other pupils within and across differing grade levels, guiding and helping "weaker" and younger pupils.

In this way, they also learn that the teacher is not the only source of knowledge.

An increasing number of educational CDs appear in the market and the relevant library for multigrade schools can be enriched periodically at low cost. It is within the intensions of the University's supporting team to produce specific educational software for multigrade schools.

6. Connection to the Internet and communication programs

Connection to the Internet and familiarization of teachers and pupils with its uses opens new horizons for learning. Thus:

The Internet can provide a practically unlimited amount of information on any topic, substituting other sources of references in many occasions. In the case of the islands provides the only source of reference. A lot of effort was put towards training the teachers to use it.

Further, it is a means for implementing distance learning. Distance education, through videoconference, took place repetitively to nearly all schools. It was used to deliver experimental teaching on sub-

jects of the curriculum, for training in the use of software, helping solve simple hardware problems etc. Under certain circumstances such distance learning could be a great part of the answer to the problems of multigrade schools.

Finally, the Internet allows communication among schools, thus reducing isolation. The web site is a platform where teachers and students of small schools can exchange ideas, present problems and search for solutions. Teachers were trained and continuously encouraged to communicate with each other, contacting schools in different islands using e-mail, e-chat, or videoconference techniques.

The web is the area where they searched for support in technical (hardware and software) and administrative problems, and -most important- the area for educational dialogue. Various web sites act as a link between the teacher and the authorities (Ministry of Education, various administration offices and between the teacher and colleagues. It is easy to understand how important this is in the case of multigrade schools where teachers are isolated, many times inexperienced and receive little (if any) support and infrequent supervision.

For pupils, the Internet is an area where they can express their ideas and communicate. Communication between pupils from different schools is encouraged through contests and joined projects, thus promoting the development of the feeling that students belong to larger communities. To help towards the above, a drawing contest and a composition contest took place last month with many entries from pupils from most schools.

It is expected that the Internet will improve quality of knowledge offered to multigrade schools and will lead to a spectacular reduction of isolation. At present however there are some problems, namely its low connection speed, its incomplete adaptation to the Greek language and the trust to the medium. The ongoing development of Internet and web applications is expected to diminish these disadvantages.

7. Conclusions

Multigrade Schools are a reality and a necessity in many developing and developed countries, especially in the remote and isolated areas.

Information and communication technologies offer a realistic and practical method of helping the teachers in these schools in many and diverse ways as described above. The results can be very spectacular and not only improve the level of teaching, but also reduce isolation of teachers and pupils.

Pupils can learn to cooperate in a more coordinated and pleasant way studying their subjects with the help of the computer or communicating through the Internet.

Distance education can be used to train the teachers and lecture the students the same. The Internet applications help the communication between the islands and the rest of the world a much-needed commodity.

The infrastructure needed is very simple and easy to get as known (telephone lines are available in every school and a very common personal computer is very cheap). What is difficult is teacher's training in IT, their conviction to incorporate some of their acquired knowledge in their way of teaching and possibly later the inclusion of such techniques in the curriculum.

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