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Maale Shaharut School: ICT in Environmental Studies ISRAEL

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OVERVIEW

"the secret of our success as a school is that we are not dealing here with technology, but with education, and the technology opened for us educational opportunities we did not have before" (a teacher)

Background. Maale Shaharut is a regional school in the southern Negev, the Arava, a desert area. It serves the population of 8 Kibbutzim[3], with a total of 715 students in grades 1st to 12th (this report focuses on 380 students from grades 7th to 12th). Due to commutation constraints, and the kibbutz ideology, the students attend school 5 days a week, from 08:00 to 16:00 (instead of 6 days a week in the Israeli educational system). The students have to work one day a week in their kibbutz in different workplaces. Some of them spend their workday in school, on the development of the ICT system. Afternoon hours are dedicated to special interest activities, such as music, sports, astronomy, etc.

The student population is heterogeneous, 70% of them come from the kibbutzim, 50 from Eilat and a nearby Air Force basis, 40 new immigrants from the former Soviet Union and 14 Ethiopian newcomers. There is a high demand by students from Eilat to enter the school, but *"It is much more important for us, at the values and educational levels, to incorporate in each class two Ethiopian children rather than two outstanding children from the city"* (principal).

The school offers a variety of learning strands, e.g., environmental studies, life sciences and agriculture, geology, geography, arts, music, fashion design, physics, electronics.

About 77% of the students pass the high school matriculation exams[5]. It is proud of its 0% desertion rate, and the last year it was awarded with the President's prize in education for its social and communitarian awareness (see kibbutz education[4]).

The educational innovation. One of Maale Shaharut main goals is fostering an independent learner. By this goal, special emphasis is put on project-based activities, alternative evaluation, independent studies, etc., as the principal explains: *"the students begin with a personal project in grade 1, and end with their final project in grade 12... in a variety of contents, and at different skill levels".* In 1999 "Mad'arom"[2] awarded one such final works with a grant.

Following this emphasis on autonomous learning, the school's Website has been developed [http://shaharoot.kfar-olami.org.il]. The Website contains students' projects, a bank of geographical and

historical textual and visual materials, learning activities, links to other Websites, and sections for special education and immigrant students. About half of the teachers integrate the use of the Website in learning activities at all age levels.

The Website components are developed mainly by the computer trustees. All other students access computers for learning at least an hour a day, and even more than that depending on the subjects. Most ICT-based work is done in teams. About 95% of the students have computers at home.

Infrastructure. The school has 85 computers (in computer rooms, science labs, Arabic classroom and library), forming a local network and connected to the Internet. Every student and teacher holds an account, and a great deal of work is accomplished by e-mail. Support is given by the computer coordinator and two assistants for the elementary and the high school levels. In addition the school gets support from the regional computer center.

For the last four years there are computer trustees in the school, who received an 80 hours training course. 50 students passed the course since then. In practice there are 10 to 17 senior trustees in grades 7th to 12th, who spend their weekly workday[4] developing the school's Website according to the needs.

THE PAST

The principal tells that the work on the school's Website begun at the end of year 1999, with the completion of the computer trustees course. The course's instructor suggested that "*instead of individual final works, let ask the students to work as a development team, there is as coordinator... there is as programmer... a graphic designer... and workers scanning pictures. I asked one of the teachers to work on liberal arts topics, while I will deal with science topics. By then I was teaching about the salt flat... and decided to do something on the topic. In December 1999 we formed a group of 20 computer trustees, 5 teachers and the instructor, and in a few days they completed the Website [http://shaharoot.kfar-olami.org.il/salt-flat/intro.html]. Then we applied for the Madarom[2] contest. I usually apply for every possible activity to get as much resources as possible for the school... that was the beginning*" (the principal).

After that a presentation on "King Salomon" received a monetary award in a Madarom contest, the students published it "*as a CDR and distributed it to other schools... it was good, and also we got some money for the school*" (a trustee). The salt flat Website was sent to an international contest of educational Websites by ThinkQest[8], "*it was exciting, everything was done with the students... but it takes a lot of work. I spent about 300 hours in guidance and writing, and Asaf (a highly talented student) about 600 hours*". Out of thousands of Websites the salt flat site ended up among the semifinalists. Since then the Website developed into a dynamic knowledge base constantly updated with the students' projects on varied topics (e.g., the nearby historic copper mines, biotope).

The principal is the leader of the school's innovative processes for 6 years now, assisted by 4 coordinators and the computer trustees students group. He sees himself as leader and guide: "*I believe that when he moves ahead he pulls ahead the others... teachers as well as students*".

ICT implementation in Male Shaharut faced problems at three levels: infrastructure, teachers attitudes, and the Website development.

Infrastructure: More computers and peripherals are required. "*It is not always possible to find a free computer*" (coordinator), "*we need a computer lab where games are not allowed, only work*" (a student). In addition, more resources are required. For example, *"students download music, video clips and games from the Internet, saturating our servers. In one hand we want to give them freedom, but in the other hand this fills-up all the disks"* (computer coordinator). The teachers try to deal with the problem by explaining it to the students and increasing their awareness to it.

More grave are cases of vandalism. *"This week we entered the Lab and found that all the mice balls have*

disappeared.. We think we know when that happened and what class was in the lab... this is serious" (computer coordinator). *"There are only few cases of vandalism, but these few are annoying"* (principal). In some cases students who where dismissed from class, come to the Lab and cause damages entering the servers with another student's password, *"and then it takes 20-30 expert's hours to fix the damage"*. The staff deals with this problem by means of the school's "declaration of principles regarding computers usage". Another way, in the principal words, is *"if you can't beat them - join them... we try to integrate them as much as we can... when we locate such a problematic child, we offer him to join not only the computer trustees group, but also one of the projects. As the principal I believe that every child should be 'connected' to something, at least one day a week he should feel happy to come to school"*.

Teachers' attitudes towards ICT: All interviewees agreed that most teachers still have difficulties in integrating ICT in their teaching. A parent told that her son included in his 'family roots project' *"an audio file with Sinatra's song 'I did it my way', and the work was not even presented in class. The teacher did not even notice that the file was there because her difficulties with the computer... it was sad"*. The computer coordinator recalls that *"it is difficult to describe the situation here 5 years ago... almost all teachers had fear to approach the computers. We had to start with many hours of training, external consultancy, and meeting during holydays and recess times, and there were things that we obliged them to accomplish. Today they have to report their evaluations on the computer. Gradually it is being assimilated"*.

The school's Website: The development process of the Website unveiled several problems. One of them was the language -the use of English. *"I know English very well, my father's mother tongue is English, and that helps a lot. But some children had great difficulties in the project because they didn't know enough English"* (a student). The principal's hope was that the English teachers will help: *"I thought it will be nice if students, as part of the English lessons, could translate the materials for the Website into English... and also get credit for it in their evaluation files. Unfortunately I haven't succeeded in that, maybe it is my fault because I haven't spent enough energy with the English teaching coordinator"*.

Another problem was that while working on the development of the Website, the students missed many of the regular classes. The solution comprised the completion of the missing topics by the students in their own time, the consideration of the teachers towards these students, and a more equalitarian division of tasks among them.

Another problem raise by a trustee was that the definition of the aims of the Website and tits target population was in some way too loose: *"because they want more interactive activities and less text, I think we lost information... it depends on the people you are targeting at"* (a trustee).

A technical issue is related to compatibility problems between browsers (and in addition working on Hebrew web pages) by all parties involved in school, at home, or supporting research centers. The problem is being solved as computers and systems are being upgraded and integrated into one networked system with a common set of tools.

THE PRESENT

The Evaluation of Change

Patterns of transferring the innovation and ICT

Three characteristics of Maale Shaharut affect the dissemination of innovations among students and teachers: it is a small and intimate school, it works all along the educational cycle from grade 1st to 12th, and it is located far from the center of the country.

Intimacy is reflected in situations such as the one phrased by the principal: *"I eat dinner* (in the kibbutz*) with the very same child that I might have suspended for two days from school... my children learn here"*. Or by parents: *"If I meet him (the principal) in the bus I can ask about my son"; "You can contact the teacher whenever you need, on every issue"; "There are teachers here that really care and 'give all their*

souls' to the children". A student says: *"I love the openness, If I have to complain about something I'm not afraid the teacher will revenge or punish me"*. In the case of the ICT-based innovations, this intimacy affects people's attitudes different ways: in one hand, it generates social pressure, by which teachers decide to join the innovation; but in the other hand, in a milieu where everyone knows everyone, *"ICT offers a wider territorial space to act"* (a teacher).

The educational continuum allows the learning of skills and working methods from grade 1 onwards. For example, students acquire ICT skills from grade 1 while learning the regular curricular subjects. There are no special ICT lessons. They also learn from other students' work, as a teacher put it "*There is an added value when young students use their elder brothers/friends' Website's materials as consumers, and in the upper grades they become also producers. When students see the connection between the Website, the research in the field and the school activities - they can realize in their minds the scope and the depth of a topic and their role in relation to it*".

The distance from the central part of the country encourages ICT use. As the computer coordinator stated, it is because of its distance from the center of the country that the school encourages high achievements and does not want to be seen as a small school in the far countryside. For this reason ICT is considered an essential educational means allowing the students, for example, to reach experts all over the country, to take part in international competitions, or to collaborate with students in the Jordanian village of Rah'me in the salt flat project. The principal, who holds a PhD in Geology and is a lover of trips and nature, visited the village and made the contacts for cooperation in the areas of education and tourism. The cooperation begun to flourish, but due to the events in the region it was suspended. Thanks to such kinds of projects, the principal succeed in recruiting valuable resources for supporting the schools development.

Staff development concerning ICT and the innovation

The school's policy and nationally defined goals are interrelated in harmonic manner. The school is committed both to excellency and academic achievements, and to national goals such as to settle the Arava area, to flourish the desert, and to establish peaceful bonds with the Jordanian neighbors. "It was exciting for us to realize that we are going to be part of a national project, related to the Peace process" (computer coordinator, regarding the salt flat project with Jordanian students). After 10 years of ICT use in school, it is perceived as an obvious tool contributing to the individual student as well as to the whole school system.

All teachers received basic training in ICT skills, but since the last year each one advances according to her or his needs. Many teachers feel that they want to get a good perception of the technology, without dealing with technicalities, *"I'm not interested in learning programming nor html, but I want to get the general idea and spirit of things... I think we have succeeded in assimilating the computer as everyday tool, like a typewriter, a mail box, or a personal folder"*. The computer coordinator adds *"in a different situation I would have never been involved in such initiatives, looking all the time for updates in the technology"*.

Not all teachers are equally competent in using ICT. 25% are directly involved in the Websites development, another 35% store there materials they prepare for their lessons. The other teachers are not involved with ICT, and about 10% even oppose to its use in school. *"Give me free access to the University library and I will get for you materials in a tenth of the time you spend on the Internet... I would like people to remember what the computer really is: a Golem. And what is important is the human in front of it"* (a not involved teacher).

Team work among teachers has significantly increased: "the computer represents for us a very convenient playing field for collaboration". The creation of subjects such as "Culture" obliged teachers to share the development of teaching and assessment materials, and they found ICT a valuable means for *"working on each other files, reflect on them, and come ready to the meetings"*.

Leadership of the innovation and ICT

The principal and his team lead the innovation. The principal sees himself as peer to the teachers. He conceives management as a matter of leading team work towards common goals rather than as a matter of authority. Authority and respect result from his personal acquaintance with the students (by election he teaches many hours a week to maintain personal contact with them) and personal example. Also to

discipline issues (e.g., sending a student to see the principal) he responds in unconventional ways: "*I'm not too a frightening person... I play basketball with the students during recess time... you should also enjoy life*".

The teachers respect and appreciate the principal, his devotedness, and personal example. As teachers phrased it: "*at the end of the day it was a problem with the water, and the basin was full of dishes. All teachers left, and who went to do the job? The principal!"; "at a given stage I had to teach in front of him Geography, and I was very stressed, because he is holds a PhD..., but even though he is the expert he gave me the freedom to act as I understood I should*".

A warm and collaborative climate characterize the teachers/students relationships. Teachers are aware that many students master much better than they do ICT, and had no problem in admitting that when they don't know how to handle a student's question they ask for other students help. Teachers are aware of their (still) essential role in school, "*even after completing a graph using Excel, they still come to us to ask about the meaning of the X and Y axes*" (a not involved teacher).

The connection between the innovation and ICT

ICT is implemented in the school at different levels. First, its use is integrated in all curricular areas in varied ways, e.g., to store the students' inquiry projects, to use the Website's data bases in learning activities, or to carry out agricultural projects (e.g., by means of computerized irrigation and fertilization systems).

Second, ICT is used to foster independent learning, by means of tasks such as writing papers and reports, gathering information, developing a personal Website ("for my friends in Germany and Russia" as mentioned by a newcomer student), or generating collaborative situations. The principal supports the continuous development of the school's Website as a repository of cumulating knowledge, and a means for peer learning: "*it is easy for all students in a class to see in the Website a work prepared by a student, and maintain a class discussion on it*" (the principal). At another level, mutual assistance is encouraged. A teacher told that "*a 12th grade student had to copy a file to a diskette. Without any problem she asked a 4th grade child present in the room to help her. The child did all the steps (checking for viruses, copying), and when she left he asked the teacher: she really did not know how to do that?*".

Finally, ICT is used as communication means for participating in national and international projects. As phrased by a teacher: *"if we can not go now to Jordan, by pressing a key we can bring peace closer"*. In this context an important function of ICT is that it shortens the distance with the central part of the country. *"Education and ICT are not a luxury here, but a need, to compensate that we do not have great theater houses and companies, or big cultural centers"* (a teacher). Another use related to distance is the possibility to take virtual courses. *"In the future, if two students will want to learn a course it will be possible"* claims the principal.

In spite of the variety of ICT uses in school, the principal thinks that "*it is not possible to learn all subjects with ICT, and it is also unnecessary, because of the variability among students. A wide range of learning environments is needed. If 25% from the learning takes place using ICT it seems to me very reasonable*".

Outcomes

Infrastructure

53 updated computers with Windows 2000 serve the students in grades 7th to 12th in three computer labs and additional rooms. All computers are networked and connected to the Internet. The school has 10 printers, CD writers, scanners, projectors, and equipment for special education children. Software includes the Office package, courseware, programming languages, and software for image processing. Most students have computers at home.

The school's support team includes an ICT coordinator (emphasis on pedagogical issues), a computer coordinator (emphasis on technical issues), and a computer coordinator for the elementary level. In addition the school gets support from the regional computer systems office. All coordinators received technical training, and spent many hours in personal learning. The current technical difficulties in infrastructure are planned to be solved at the regional level in the near future.

The equipment in the school is updated, but it does not satisfy the demands. The students use every free computer everywhere in the school at all times, until the buses leave. *"Because so many subjects require the use of computers, even the one in my office is always busy with students"* (computer coordinator).

The schools vision regarding technology includes video-conference capabilities for communicating with experts from research institutes, appropriate communication infrastructure to allow ill students to attend lessons from home, and even the idea of one day a week in which students attend courses virtually from home.

Efficiency of the innovation and ICT

The implementation of ICT in teaching follows the teachers' conviction that their role is to generate learning opportunities. About 25% of the learning time is devoted by the students to knowledge manipulation (e.g., information search, preparation of computer presentations). *"Teachers understand today that they have became more guides or coached than deliverers of information written in their aging yellow sheets... there are still some of those, but mainly in the high school* (those teaching towards the matriculation exams)" says the principal.

The exams constraint cause teachers to renounce using ICT, *"you don't have enough time for the Internet... I spent a lot of time looking with them after relevant materials, and suddenly the last month I realized that there is no time left for many topics we did not learn, and now I'm under terrible pressure"*.

But in lower grades, ICT is used in a variety of ways. For example, a teacher asked a Russian newcomer to surf to his hometown Website, download a picture and describe it in Hebrew. *"How could I do that without the computer? That way I communicate with them, and they are excited because they can teach me about their hometown"*. A student adds: "*with the help of computers you can do everything more interactive... it is far more interesting than the boring reading of texts*".

Another project focuses on the topic of "Humans and Copper" (nearby the school are located the Tim'na historic copper mines). 9th graders prepare different works on the topic, focusing on different aspects. The 9th grade computer trustees upload the works to the Website, and generate the linkage among them. One of the students was designed the scientific consultant, responsible for all formula and scientific data. The principal is pleased with this kind of work: "*with ICT is the only area you can define your goals and the work is done within a month, and perform far more than expected*". Other projects under development are "the computerized greenhouse", "testimonies from a Shoah survivor" from Poland, and "sustainable development in the Eilat gulf".

However, ICT implementation raises new requirements at varied levels. For example, at the skills level,

"the same way a person has to learn to walk, to swim or to drive a car, he has to know touch typing at fast pace and without mistakes. We implemented such training in 7th grade once, but somehow we gave up". Another need is to prepare the students to cope with the huge amount of information in the Internet: *"handling the overwhelming amount of information in the Internet demands the acquisition of specific skills: how to classify, how to discover what is of interest and what is superfluous" (a teacher). "they are not able to hold a face-to-face discussion, and If we will not teach these skills I think we are loosing something valuable".*

Academic Strictness

By its vision, the school aims to promote every child, encouraging independent learning and adaptive instruction. Principal: "*I am a great believer in the need for a variety of teaching methods... the same content should be conveyed by a lecture, an experiment, a trip, computer work, slides. From my experience, every child's 'aha!' comes at a different pace*". However, at the same time the school places high demands on the students regarding attendance and academic achievements.

The school's Website represents a rich learning environment, of which every student can benefit both as producer and consumer. The following are but a few examples. In an Arabic lesson 10th grade students got the assignment to look at the caricatures in the Israeli and the Palestinian online press, to compare and elaborate on them. The teacher adds: "*from time to time I let them surf Arabic language Websites, to acknowledge how developed is the Arabic world on the net...there is any (formal) learning in that? No, but widening horizons? for sure!*". In a History lesson we observed a contest of PowerPoint presentations on witches in the Middle Ages. The students presented their work, and were evaluated by their peers: on mastery of contents, creativity, aesthetics, level of interest, originality. In the computer Lab a student was finishing his final project for matriculation, on a biotope. An 8th grade student worked on a computer film comparing kinds of rocks. 9th graders designed calendars, among them Ethiopian children who used half white/half black backgrounds upon which they added pictures of white and black children. *"Without the computers, all this would have been of no interest, not fun"* stated one of the students.

ICT work also generates new roles for the students. For example, for the project on the Timna's copper mine Website, several functions were defined: A 9th grade student was appointed as the scientific consultant for the project; another student delivered a html course to his peers; a computer trustee coordinates the work, distributes the tasks, and help the "script writers" in their job; advanced students do the Java and even the Visual Basic programming. "*There is a function in Visual-Basic you don't have in Java. So we wrote the function for the search engine, and whoever will need it can use it*" told one student. Another student: "we did a humoristic program for a company that sells stationery products... and the whole class took part... it is in the Web, all the pictures and all the products, and a shopping cart".

ICT work affects the school's climate and work, as perceived by the students: "it is more free...if you have to deliver a presentation, you do what you think you have to do, what is important is that at the end you have your presentation... it encourages collaborative work, one prepares the texts, the other the graphics".

The teachers claim that the computer contributes to knowledge construction processes: "*you manipulate pieces of information, and through that they get better order in your mind. I think that this should result in an improvement in achievements*". "*Organizing concepts using graphical means, helps the students in thinking and internalization processes*". However, another teacher thinks that *"sometimes I get 'empty works', they are pretty, with pictures, well typed, but poor in content... we don't let students to get away with zero content... because of the computer possibilities, there is no doubt that the quality of the works has increased".*

Not everyone is happy with the fact that the students spend plenty of time with the computer. *"it disconnect them from books"* claims a parent. *"they work with computers, but are not able to explain by a normal sentence in Hebrew what are they doing"* agrees a teacher. Another teacher maintains that *"we guide them too much towards what they want, and give up too easily on what they need".*

Equity

On the question of who gets the more from the computer there are different positions. All agree that the computer trustees group gains a lot. "*They are a selective group, to whom the computer means a lot, and you can trust them*" (principal). One such student said that "*the programmers are the wisest people in the world, because all the time they develop new sites, and learn new things. Because I will be developing the Timna site, I'll learn a lot about Timna. This is a better way to learn, rather than sitting in a boring lesson*".

Another group who gains from the activity are the special education students, "*that suddenly discover that what they could not accomplish before they can now*" (a teacher). Also "problematic" students with behavior problems benefited from ICT activities. For example, a 7th grader who was excluded from all courses, was offered to be the first in doing the "family roots" project with the computer. "*In the Passover recess he sat for six hours without leaving the chair, and the same for the whole semester*" (the teacher). Another very problematic student became a computer trustee.

An important use of the computer is with students with special needs (dyslectic, handicapped, down syndrome). For example text to speech features allow students to go again and again over texts, or work at their own pace within the regular class eliminating the "special ed class" tag. The computer also benefits students "*who have attention or concentration problems within the whole group, but reach incredible achievements with the computer*".

Girls benefited less from ICT activities, and a few of them only are in the computer trustees group. A teacher argues "*I don't know the reason. It was suggested to open a course for female computer trustees, but as today we did nothing about that*". A student adds that "I don't want to generalize, but they simply don't like these activities, they prefer Barbie dolls and music, and it is a pity because this is the tool of tomorrow".

MAIN HYPOTHESES

The Role of Technology in the Innovation

In Maale Shaharut there is no doubt that ICT was assimilated as an additional resource to the innovative forces already acting. The Junior High coordinator tells: "*the real answer to the question of innovation does not rely on the computers. In activities carried out six years ago, we spend about two years on two issues: the school's aims and goals, and the school's declaration of principles regarding teachers/students relationship. These two things clarified us what are we doing here...and we translated them into a whole system: alternative evaluation, project-based work, and also to the school's Website project*".

Another teacher adds: "*this project was not born in a vacuum, but following our search for didactic solutions for the students... side-by-side with the flourishing of ICT, we developed other strands such as music, arts,... our motto is 'ICT in the service of pedagogy'... and we want very much to live in the 21st century to use ICT at the highest level possible to reach pedagogical goals*".

Also the teachers teamwork, which improves all the time, is supported by ICT. As one teacher explains: "*the computer is not the reason, but offers us a very convenient playing field to act... you can store drafts, document the process... you can see the improvement of the product in all its faces*".

Transferring the Innovation

The dissemination of the innovation in the school proceeds according to the patterns described by Rogers (1999), but not in even way. Within the school there are islands of rapid adoption, of slower adoption, and even others of denial.

Rapid assimilation was done by the principal, the leading team, and the computer trustees. "*They are the ones really connected... they carry out the process. It is true that I'm the number one. It is in my head, it is important to me and I learn a lot from it, but the innovation depends on the team... pedagogical coordinator, computer coordinator, and a group of people able to work together as a team and collaborate... without them the project will not continue*" (principal). Also the computer trustees have assimilated the innovation very rapidly, and were absorbed into the schools needs "*they taught teachers and instructed then one-to-one, they entered the classes as assistants to the teachers, they were appointed as curricular developers*" (teacher).

Slower adopters of the innovation are teachers who recognize the importance of ICT, but they don't want to become addicted to it: "I don't disregard the computer, but neither want to participate in this awful festival around it and the Internet".

The deniers are those teachers who see in the computer an obstacle in the attainment of their educational goals. For example, the math teacher does not want to use computers because this does not help him to prepare the students for the matriculation exam.

It seems that one difference between these groups, besides personal differences, is the fact that some of them depend on external evaluation criteria such as the matriculation exams. Those teachers who have to prepare students for these external exams are afraid of the effect of ICT on their students ability and theirs own to succeed.

Implementation of ICT

More than the teachers' overall level, key factors for the assimilation of the innovation in the school were the students' high level of expertise and the quality of the infrastructure.

The computer trustees group (10-17 students) is the main force behind the development and maintenance of the school's Website. As one of them (a 14 years old boy) told us: "*there are many teachers asking for help. There are so many projects going on in this school... but they have to be done, so they ask the students for help*".

However, it is clear that in spite of the difficulties and some resistance, it is the teachers supporting approach and their willingness to excel that facilitates the adoption of the innovation.

Digital Gap

All students in Maale Shaharut receive similar opportunities and conditions, so there are not SES based differences.

There are of course individual differences. There are differences in predisposition towards the technology. And differences in the students readiness to share her or his talents with others: "*most computer trustees are not computer-freaks... There are some but we don't ask them to join the trustee's group. Why? Not always a computer-freak knows how do explain others how to work with computers*" (a teacher).

Another difference is based on cultural background. The school absorbed this year 14 Ethiopian newcomers. "the group who came to us was at the equivalent of 3rd grade level. Put them together with the computer trustees... with all the cultural differences... this is the biggest project we took upon ourselves, and the price is high. It was a great mess at the beginning of the year, it was very difficult for the teachers, now things are more quiet. Many resources were invested on their integration into school, and we don't get almost nothing from the state, the Ministry added us only a half time position, while we added three. Also other students teach them" (the principal).

In summary, differences among students have different causes, but ICT is not one of them, the opposite, many times it contributes to closing gaps.

Academic Standards

Aspirations for high achievements and excellency characterize the school. ICT is perceived as a supporting means for these aspirations. Decision making is affected by budget and technological changes: "*you buy courseware, then you upgrade the school's network and 80% of the materials can go directly to the trash... the rate of change of the technology makes useless to invest in courseware. We gave up on that, but not completely, for example, there is good software for learning English or Arabic*" (the principal). The principal prefers open and generic tools, and conceives the school's Website as a learning resource by itself: "*our educational rationale states that we will build it layer over layer. Today we are working on the fish project, next year students will build upon it and continue further on*".

Parents are somehow worried about the computer's role in improving their children's academic achievements. In one hand, a parent testifies that "*if not for the computer my son would be in the lower part of the scale*". In contrast another parent is concerned because "*I don't see them reading books... I don't know how come they are so good if they don't take a book on their hands*". "*maybe they read on the computer*" (a mother). "*no, on the computer there are only games*". In any case the parents agree that the contents being learned nowadays is of a very high level.

The students themselves claim that they learn about new contents while dealing with the technology: "*I have learned a lot of things I did not know before... about copper, salt flats, algorithms*".

IMPLICATIONS FOR THE FUTURE

Stability of the Innovation

The teachers believe that the innovation will continue all the time the principal stays in the school, because "*he is devoted to it, and has the ability to 'pull in' people and create teamwork*". "*Now that the infrastructure was built, things start running by themselves... an engine was built and now it runs itself*" (teacher). The teachers talk about a stable group of teachers and students committed to the innovation's stability and continuity. The computer coordinator believes that the innovation will continue because it contributes to the school's renewal, and the students like it and learn with it.

A key factor is the principal's support for any required organizational change: e.g., time and classes distribution, or differential allocation of personal incentives and teaching duties. Important as well is the Ministry supervisors' support of these changes. The school pertains to the kibutzim's school system department (in the Ministry of Education), which is more flexible and tolerant to changes and innovations than the general school system department.

The motivation of the leading group is another key factor for the innovation's sustainability. "*I don't know how did I find 300 hours to spend in the project... I'm a full time teacher, I'm the principal, I teach in the University, I have 5 children at home... and the best thing is that I don't own a car, so I know that by 16:30 I go home with the school bus and spend time with my children... not less important*" (the principal). The junior High coordinator adds: "*12 years I grew dates... in my soul I'm a farmer, I faced a dilemma, and then I told myself that 'the threes will grow anyway', so I'm going to work with the principal. We work very well as a team. There are things that he is better at than me and vice versa. There is something very important in a leading figure, but there is something even greater in a leading team*".

The innovation steadiness also depends on the delicate balance between the continuous generation of new projects and their exposure to outside-school factors (national and international), and the stabilization and maintenance of existing projects: "*there is a limit on how much you can load upon the school's, teachers' and students' shoulders*" (principal).

Finally, a continuous investment in equipment and maintenance is required, most of these funded today with school resources. Without a serious external support it will be difficult for the school to continue.

Transferability of the Innovation

The transferability of the innovation to other schools demands three key elements: people, funds, and a vision.

People: First an "*obsessed person is needed, the one who carries the flag... who has the charisma, the knowledge and the capability*" (computer coordinator). Then the people, "*you have to identify dominant people... those who are able to raise it... and put together the right person with the right project*" (principal). In addition it is important to dilute resistance.

Funds: A parent observed, "*The school's operating expenses are very high... If we had to pay a tuition, most children would have not been studying here*". Besides the regular funding, the kibbutzim served by the school contribute additional resources. "*We have here a full time position for a computer coordinator, and I don't think that if someone says 'I also want' the next day he will have in his school a complete network of computers, Internet, etc. This kind of projects require investments, both money and time... we here are already working for two years and the system is still uncompleted, and I think it will never be*".

A vision: "*The technology is a necessary means, perhaps it is impossible without it, but for sure it is impossible without a pedagogical rationale. Every school should develop its own rationale and use the technology to foster it. With a vision and believe, what takes place here can take place everywhere. Our staff is good, but not an exception... the greatness of Maale Shaharut resides in that that it proves that everyone can do it*" (Junior High coordinator).

An important factor is the dissemination of the acquired experience. The ministry of education asked the principal to instruct and coach staff in other schools. "Thus I wrote a guide, but they want us to come and work with them... but we have a problem: the distance". The principal maintains that meetings between school teams whit common interests generate a dynamics of mutual enrichment. The principal: "*suddenly a large amount of knowledge cumulates, and you don't know how to disseminate it among schools and teachers... I don't know if in the ministry there is a function in charge of this. I have no doubt that meetings and information exchange among teachers are very important. It was never the case that I went to a school, and did not bring something back home*".

APPENDICES

Appendix 1: Methodology

Research Team: The research team comprised 7 researchers. Due to the distant location of Maale Shaharut, this large team went to the school for two days in May 2001 to do all data collection: interviews, observations, questionnaires.

The Data: The chart below describes in detail all data collection activities. All interviews were recorded and all observation details were written down. All data were transcribed into digital files and uploaded to the Israeli research Website in Tel Aviv University, at http://muse.tau.ac.il/ict/.

The average length of each interview was an hour and a half. The focus group interviews were longer (about two hours). The observations lasted the length of the lessons, usually 50 minutes. The report was written by Dr. Dorit Tubin, then sent to the team members for verification and comments.

Interview and Observation Chart for Maale Shaharut School
May 2001

Research Tool/Activity	Date and Hour	Name of Subject	Function
Pre-research meeting	3.4.01, 14:00	Hanan Ginat	School principal

Pre-research meeting	13.5.01	Hanan Ginat Dana Gomez Michael Levi	School ICT team
Administrator interview		Carmela Amar	School regional instructor
Principal interview Principal questionnaire	13.5.01 14.5.01	Hanan Ginat	School principal
Computer coordinator interview Computer coordinator questionnaire	14.5.01, 14:00	Haim Kantor	Computer coordinator
Observations Observation 1 Observation 2 Observation 3	14.5.01, 7:20 14.5.01, 8:00 14.5.01, 12:00	Shlomo Hanan Ginat Hanan Ginat	History teacher Geology teacher + principal
Interview with involved teachers	14.5.01, 9:35	Shmulik Bezalel	Bible + literature
Interview with uninvolved teachers	14.5.01, 12:00	Shmulik Yair	Biology teachers
Interview with students	13.5.01, 13:15 13.5.01, 13:15	Igor Bogoslavitz Ori Weiss Nir Ben-Menachem	8th grade students 12th grade student
Interview with parents	14.5.01, 9:00	Rafi, Adina, Nissim Yaffa	Parents of 8th-12th grade students
Teachers skills survey	14.5.01		
Additional materials	14-15.5.01	Web sites, brochures, special issues	

Appendix 2: Teachers' Computer Skills

The questionnaire was handed out in the teachers room, and filled out by 9 out of 45 teachers on the school staff.

Results

	To what extent do you feel comfortable using ICT in performing the following tasks? 1 very comfortable 2 comfortable 3 somewhat comfortable 4 - not comfortable at all				
		1	2	3	4
1	Writing a document	6	2	1	0
2	Searching information in the Internet	4	3	2	0
3	Forming web pages and maintenance	1	1	2	3
4	Using databases	4	2	2	0
5	Developing databases	1	2	1	3
6	Sending/receiving e-mail	5	3	0	1
7	Writing plans on the computer	1	2	2	2
8	Preparing pictures, diagrams or charts	3	2	2	2
9	Organizing information in a presentation	3	0	3	3

	To what extent are the following computer skills important in your education work? 1 very important 2 important 3 somewhat important 4 - not important at all				
		1	2	3	4
10	Writing a document in a word processor	7	2	0	0
11	Searching information in the Internet	4	0	4	0
12	Forming web pages	0	0	2	4
13	Using databases	3	1	4	0
14	Developing databases	0	2	4	1
15	Sending/receiving e-mail	2	3	2	2
16	Writing plans on the computer	0	3	2	2
17	Preparing pictures, diagrams or charts using graphic software	4	1	2	1
18	Organizing information in a multimedia presentation	1	2	4	1

	How often do your students use the following computer in assignments you handed them during the previous year? 1 a few times a week 2 a few times a month 3 sometimes 4 - never				
		1	2	3	4
19	Using the Internet	1	2	2	3
20	Forming web pages	0	1	0	7
21	Sending/receiving e-mail	1	0	2	5
22	Using a word processor	1	4	0	2
23	Using computer games	0	0	2	6
24	Using electronic charts	0	0	2	5
25	Using graphic software	1	0	1	6
26	Joining a virtual forum or virtual discussions on the Internet	0	1	1	6
27	Using software for a multimedia presentation of information	0	1	1	5
28	Using drill and practice software (including simulations)	1	0	3	4
29	Other computer uses (please specify): **music software**	1			

		Good	Mediocre	Weak
30	How would you define your ability to use computers?	5	1	3

	Answer the following questions relating to your prior experience or to ICT implementation in teaching\learning during the past year.		
		Yes	No
31	Had there been assessment of computer usage among students?	4	3
32	Can you create or alter a web site with one of the classes you teach?	1	7
33	Do you participate in a virtual course on the internet as a student or tutor?	1	8

34	Do you involve your students in collaborative learning on the Internet with students from other classes in other places?	2	7

		All of it	A large part	A small part	A minor part
35	What part of computer usage during the lesson is aimed directly at the lesson content?	0	2	2	4
36	What part of the computer-related assignments is for individual usage?	1	1	3	3

		No limitations	Some limitations	Distinct sites only
37	Do you assign your students to search the web? What is the degree of freedom you allow your students while doing so?	3	3	0

		A few times a week	A few times a month	Once in a while	Never	I don t own a computer
38	Do you own a personal computer? How often do you use it for your work?	5	1	2	1	

		Yes	No
39	Do you use technology to collaborate with other teachers? (professional chat rooms, forums etc.)	2	6

		More than 12	6-11	1-5	None
40	How many messages (average) do you send a week by e-mail?	1	2	4	2

How many of the following activities can you perform?		
41	Altering hardware	3
42	Updating/upgrading applications, such as word processors, graphic software etc.	6
43	Restoration of files	2
44	Site construction	3
45	Developing databases	3

Appendix 3: Samples of Activities

Worksheets with guidelines for the computer trustees

Plan for the development of the Website:

The Aqaba gulf - sustainable development

We succeeded already in building together the following flowchart, which describes the structure of the Website. What next?

1. The development of the entrance page to the Website in English, with a short description of its contents

2. The design of the second page of the site, with a large picture (responsible: Ch.) and the menu. E. and Z. are responsible to complete the menu during this week.

3. Organization of the information to be included for the different topics, from the works done by the 12th grade students. At this stage the contents will appear in Hebrew and English, and in the near future also in Arabic (translation W., responsible Ch.). The pictures taken in our recent trip should be included, as well as scanned pictures from the books.

4. It is important to contact R. from Aqaba, for her to send us pictures and text related to the Aqaba port (Jordan).

5. We should complete the applications to ThinkQuest during the next month.

6. It is important to continue the development during the next couple of weeks of SimGulf, so we can get the advice of D. in our next meeting - May 13th.

7. We should check with A. on the use of the scientific tools he developed for the salt flat. He will get all the credits for that.

8. The Website should include relevant links to other Websites in Eilat and Aqaba, preferably sites in Hebrew, Arabic and English.

9. Inclusion of a large picture of the whole gulf of Eilat, as part of the geographical background.

10. Finishing the agreement with the air photography company, to use one of their pictures.

11. Completion of the Websites flowchart.

Guidelines for the continuation of the development of the Website

"Humans and Copper"

"Accomplish what is needed, aspire to what is possible, and then discover that you are doing the impossible"

We do continue, and with all our energies. By the end of the month we will be presenting the project before

the students and parents of the 9th grade. During the month we will finish the applications to ThinkQuest. How do we continue from here?

On the history of copper mining and production

Work to be done by student O.:

1. Completion of the game board with its 32 squares (4 for each period)
2. Preparation of the html page with the questions and answers.
3. Completion of the section "additional information" and links with archeology.
4. Drawing of a room with a human figure dressed according to the period.

Work to be done by student A.:

1. Implementation of the game's engines.
2. Linkage between questions/answers and the game board.
3. Programming the activations: clicking on copper products shows appropriate texts.

Copper mining and production today

Work to be done by student B.:

1. Preparation of 15 cards with pictures
2. Preparation of a logo for the cards
3. Completion of all textual information
4. Completion of all chemical formula (with the help of T.)

Work to be done by student A.:

1. To arrange the zooming on every card
2. To complete the game's mechanism

Copper's ID

Work to be done by student D.:

1. Completion of 10 trivia questions
2. Final design of the copper's id web page
3. Design of a room with copper objects and raw copper

Appendix 4: Glossary

1. **Tomorrow 98**. A 5 years national plan conceived in 1993, towards the 50th anniversary of the creation of the state, aiming to advance the educational system in the areas of math, science and technology education. One of the components of the plan was the gradual completion of ICT infrastructure in all schools, and the supply of appropriate support (e.g., training, learning materials development) for ICT implementation.

2. **Madarom**. An educational/organizational framework created following the recommendations of the "Tomorrow 98" plan, aimed to promote science and technology education in the southern areas of the country in all grade levels. Madarom is a joint venture between several foundations and the Ministry of Education. It supports the implementation of a varied range of activities in about 830 kindergartens and 385 schools, as well as in informal education centers, from 40 communities (towns, villages, regional councils).

3. **Kibbutz**. A democratic and equalitarian society self-managed by its members, who freely decided to join the community guided by a deep commitment to its ideological and philosophical foundations. The kibbutz members share the ownership over all material possessions and production means,

pursuing principles of independent work and collaboration in all areas of economical activity and community life. The community is characterized by its social openness, readiness to adopt technological innovations, and the high level of its educational system. The kibbutz form of life is unique to Israel, first developed about 100 years ago when the Jewish immigration back to the homeland started. Today there are several hundreds of kibbutzim in the country (about 3.5% of the population).

4. **Kibbutz education**. Unique characteristics of this educational system are the intricate interrelationship among all educational agents (school, parents, community), its being non-selective and equalitarian (e.g., no compulsory streaming of students based on achievements), fostering autonomous learning and work with guidance by the educators, and support for immediate integration into the kibbutz life after finishing school. One of the components of the students' weekly schedule (mentioned several times in this report) is the workday, in which students take part of the regular work tasks in the kibbutz.

5. **Matriculation exams**. External and standardized national tests, by which the educational system extends to students who completed 12 years of studies the matriculation diploma. The main aims of these exams are: to test the level of knowledge and skills acquired by the students in their studies; to set national and standardized levels to which all schools in the country have to adjust; to serve selection and admission processes by higher education institutions based on level of previous academic achievements; to serve as formal summation of the studies in the high school level.

6. **Final work**. An independent project (theoretical, experimental or practical) which the student is allowed to perform and present in her/his last year of high school as part of the duties for receiving the matriculation diploma.

7. **The direction of the kibbutzim educational system**. In administrative terms is one of the 9 regional departments in the Ministry of Education, and holds the authority to execute the Ministry's policy within the schools under its administration. This capability includes issues such as allocation of human and other resources, supervision of the schools functioning, and encouragement, support and supervision of innovative activities.

8. **ThinkQuest**. It is a global network of students, teachers, parents and technologists dedicated to the exploration of youth-centered learning over the Net. ThinkQuest is an online community where young people learn, teach, mentor, discover, research and grow using ThinkQuest programs. This virtual world encompasses young people, technologists and educators in more than 100 nations, working together as digital learners, web creators and net entrepreneurs.

http://www.tinquest.org/