HOW DO INDIVIDUAL PORTABL COMPUTERS EFFECT STUDENTS' LEARNING?

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Abstract: *Investing in portable computers for students is a controversial issue. This paper focuses on pedagogical aspects of such an endeavour. It reports on a case study of portable computer use by students in the Master's degree program in Information Technology at Uppsala University, Uppsala, Sweden. The results are promising, indicating that in general students learn more and that they use the computers for colaboration.*

LEARN TO LEARN

We educate our students for a changing world. Crucially, students must "learn to learn": to be prepared for future changes, and to continue learning through a whole career. This influences the activities of the universities: we must create an educational environment where the students are encouraged to become interested in the underlying principles of their subject area and where they become a part of the development within their fields of expertise.

These statements apply to all subjects, but the effects of change within computer science and information technology are spectacular. The computer has a double function for students in these disciplines: both as a tool (e.g., for retrieving information) and per se as a study object. Yet we know that the tools we present to our students will be obsolete in ten years, and that the students will have to learn −− if not develop −− new tools by themselves during their careers. Further, the size and the complexity of today's systems (e.g., Internet and GSM) make team work necessary and also possible, so we must also prepare students to work in teams or groups.

So, what happens when we make our tools−cum−study−objects more accessible, even more common place, among our students?

A study − Individual portable computer for IT students

In 1997, the Department of Information Technology at Uppsala University, Uppsala, Sweden loaned portable computers to all students (30 individuals) in the third year of the Master's Programme in Information Technology for their individual use during the spring semester. The computers were AST Ascentia P100's, with 24 Mb memory and 2,1 Gb disc −− at that time a top−end computer −− equipped with Linux and Windows. As a requirement for borrowing the computers, the students agreed to participate in the interviews and questionnaires in a study. The students' use of the computers and the effects of that use on their learning were evaluated.

Purpose

Our aims in loaning computers for individual use were primarily pedagogic. We anticipated that the potential for continuous access might result in the computers' integration into the students' everyday activity, with beneficial results for particular educational objectives:

- *Knowledge and skills in computer science*: The students should learn to master, change and develop systems where computers are central. Säljö [2] stresses that an important skill for these students will be to interact with computers, to know their potentials and limits. Would this sort of knowledge result from continuous access to a given computer?
- *Group work skills*: Students should be encouraged to work in groups and be taught how to do this. Would ready access to electronic communication and record keeping facilitate group interaction in various forms?
- *Skill in using the computer as a tool*: Students should learn to use the computer as a tool, for example as a learning tool to search for information. Would the students use the computer to assist in other tasks, for example making more or different forays into the world of the Internet?

There were also practical considerations:

- If the students had portable computers, fewer computer lab rooms would be needed.
- We also envisioned that much of the maintenance would be handled by the students themselves.

Data for the study

Data was collected through a series of five questionnaires given to all students (web−based except on the first

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occasion) and through a series four semi−structured interviews each with six selected to be representative for the student population in question.

Both the questionnaires and the interview questions were created for the purpose of the study. Particular attention was given to the following areas:

- students' learning of computer science
- students' willingness to collaborate with each others in their studies, and their opportunities and mechanisms for doing so
- students' ability to use the computer as a tool for word−processing, dealing with large amounts of data and for seeking expert help etc.

RESULTS OF THE EVALUATION

This paper presents the most important results. The full report, available in Swedish, gives complete data and more general information, mainly referring to local information as availability of labs and organisation of course modules.

A caveat: Given the many non−academic reasons for wanting to have a personal computer (e.g., to use for games, to flaunt as a status symbol), one might assume that students would distort their responses tactically, giving unrealistically positive replies. And the study may indeed have a slightly optimistic bias. Yet all students interviewed also talked about their negative experiences, difficulties, and problems. The material collected showed a good inner consistency across sessions and between questionnaires and interviews. Similar issues arose both in the interviews and in the questionnaires, but in different words. Therefore, we believe that the study is reasonably reliable.

Time spent with the computers

On four occasions, the students were asked how much time they had spent working with school issues on the computers. They were also asked how much time they had spent in the labs. Table 1 below shows their average working time.

Table 1. The use of portable computers and computer labs

	Use of portable		Use of labs	
	Hours	Percentage	Hours	Percentage
Week 0	7.64	69%	3.44	31%
Week 4	12.5	90%	1.43	10%
Week 8	10.1	86%	1.58	14%
Week 12	37.8	96%	1.71	4%

It is clear that the students used the computers. Not only did they report it, but we saw them doing so, for example taking notes in class, or sitting over a portable in a lounge. The time they spent in the labs, and thus "blocking" one of the regular computers was low as well.

In the interviews, many students stressed that the computers gave them freedom. They claimed that this was a main reason for them using the computers so much.

> Student:
> You have a better possibility to work, and it is more encouraging, more fun, to work. These two things together, makes you work more, and learn more.

> Student:
> You get an idea, you sit down at the computer, and you try

> Student:
> You can work wherever you want to, and whenever you want to, and you have a real computer.

The students judgement of the computers

In general, the students were satisfied with the computers. They showed a detailed and thoughtful image of their usage of them, and they pointed out problems.

The interviews confirmed this picture. The students claimed that the computers were useful in their studies, but they did not have an uncritical picture of how they were used.

What have the students learned?

In one of the questionnaires the students were asked to judge statements about what they have learned. Some of these statements were phrased as a negations, that is contained an "extra" "not", to avoid the students following a "mechanical" pattern when filling in the forms.

In table 2, below, are three examples of these statements and the answer rate.

Table 2. The students' judgements of their learning.

Statement	Do not agree	Neutral	Agree
I do not think I have learned very much about the use of computers by having a portable computer	75%	25%	0%
I think I have learned Linux or Windows by having access to the computers	16%	47%	37%
I mainly use the computer for games, when I do not do assignments	74%	21%	5%

The students showed a large variation of opinions. Some of them pointed out specific skills they learned, while others emphasised that their knowledge had deepened.

One of the students expressed hesitation:

> Interviewer:
> [...] the system, Unix and Linux?

> Student:
> I have not learnt very much [...] maybe you are lazy [...], other things turn up.

Other students expressed doubt on other grounds:

> Student:
> So I have been playing and looking around. But I have not done very much [...] , not going into details. I do not think I dare, scared, yes, that something will get destroyed [...] not so used to this [...] hard to know where to start.

> Student:
> [...] operating system, there I have not learned very much, DoS and Windows I think I knew before.

Others indicated that they have broadened their knowledge:

> Student:
> Yes, [laugh] it is hard to know exactly what you have learned. [...] Linux, that is for sure. [...] good understanding of Word and so. And Excel, you know[...] But it feels as if it was mainly an improvement of earlier skills and knowledge

> Student:
> I think you have become better in using the computers.

Many students indicated specific skills that they had attained: Word, Excel, Linux, Windows, Perl, HTML were among the tools mentioned. It is clear that a majority of the students learned from having access to the computers. But their comments also indicate that there is a large variation in what they have learned.

Attitudes towards collaboration

The statements below highlights the students attitude towards collaboration.

Table 3. Students' attitudes towards collaboration.

Statement	Do not agree	Neutral	Agree
I do not think that it works well to work in groups around the computer	71%	24%	6%
I prefer to work alone at the computer	32%	47%	21%
I think that my friends are good sources to knowledge about the computers	17%	33%	50%

These statements were correlated to other, similar statements. We take the strong correlation between the answers as an indication of consistency in the material.

One of the students commented on the plan of the department to encourage cooperation:

> Student:
> The word [how to connect a printer] is getting spread in the class, but that is how it is planned, I'd say [...]

The students gave a number of different descriptions of the ways in which they collaborate. They can sit together at one computer, possibly with a big screen, or they can be at individual computers, but close to each other in order to discuss issues that arise. In other cases students meet to divide the work, then do large portions of it individually, and finally meet to create a whole of the pieces.

Many students report that they worked in different ways on different occasions. The choice of method varied both with the task and over time. Sometimes the students stimulated each other to improve the results.

How do the students learn?

The statements in table 4 concerns students' learning

Table 4. Students' statements about how they learn

Statement	Do not agree	Neutral	Agree
I do not think that I will forget what I have learned as fast as I forget [...] lectures [...], or book	0%	22%	78%
I learn the best by trying out the computer or a programor a program, alone or with friends	17%	44%	39%
It is easy to understand different concepts, when you can try on the computer, alone or with friends	17%	33%	50%

The material indicates certain factors that affected the students' study habits. The answers in the interviews underline these factors, and give possible explanations.

Some students indicated that having the computers encouraged them to try things out on their own:

> Student:
> You have been sitting and playing, with the assignments as a basis, [....]. Because, at home, when you have nothing special to do, you take the computer out [...] In this way, I have got more things done.

Others have taken notes, or made summaries of lectures of courses, while still others have found inspiration to try new ideas.

There is a large variation in how the students used their computers as tools for learning. It is clear that, for some, their study habits have been affected, and that the changes in many cases are an improvement. However, the material

also shows that the study habits have not changed for some of the students.

For whom is the computers an advantage?

A relevant question to ask, is for which students these computer are an advantage, and for whom they might be a disadvantage.

To address this question we have selected subgroups based on:

- Gender
- Student's study orientation according to Gibbs
- Previous study results

We studied these subgroups' judgement of the statement: "As a whole, I am satisfied with the computer".

There were only two females in the group. With this limited material, there is no visible difference in gender.

Gibbs[3] differentiates between students with an achieving orientation ("doers"), students with a producing orientation (who often try to learn the text, rather than the actual subject), and students with a meaning orientation (who look for a deeper understanding of what they are learning). We used a modified version of Gibbs' form adapted to the local situation. When grouping the students in this way we did not see any significant differences.

We also studied students with exceptionally good earlier performance, and students with exceptionally weak results, to see if they showed any differences from the "unexceptional" group. There are no important differences between the groups, except that there is a tendency for the weak students to be less satisfied with the computers.

CONCLUSSIONS

It is clear that the computers have been profitable for the students' learning of computer science and for their interest in collaboration, while the effect on handling large amounts of information was limited.

There is no strong evidence that students with different learning styles react differently to the computers. There is a weak tendency though that "good students" take greater advantage of their computers than "weak students".

The overall experience is that individual portable computers are useful tools for the students' learning, but that the infrastructure and the courses have to be adapted to the new situation before the students can take a full advantage of the computers.

Acknowledgement

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