From the Symposium Chairs

Welcome to the first AlBaha University – Uppsala University Collaborative Symposium on Quality in Computing Education (ABU3QCE), held in AlBaha, Saudi Arabia, 24-25 February 2015.

ABU3QCE 2015 is a local symposium dedicated to the exchange of research and practice focusing on enhancing quality in computing education. Contributions cover a broad spectrum of computing education challenges ranging from; computer science, computer engineering, computer information systems, computer information technology to software engineering education. ABU3QCE aims to publish research that combines teaching and learning experience with theoretically founded research within the field. The proceedings papers cover a wide range of topics such as cultural aspects of teaching and learning, technology enhanced teaching, and professional competencies and their role in the curriculum and in higher education.

The symposium is a collaborative initiative of AlBaha University, Saudi Arabia, and Uppsala University, Sweden.

It is our hope that this symposium will highlight current efforts, and also be the starting point for discussions, and inspire others to contribute to take the quality of computing education one step further.

Welcome to AlBaha!

Aletta Nylén, Uppsala University, Sweden
Mohamed Shenify, AlBaha University, Saudi Arabia
ABU3QCE 2015 Symposium Chairs
Paper Sessions

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The Study Process of Computer Science Students at AlBaha University: A Preliminary Study

Rahmat Budiarto¹, Mohammed Saleh T. Alghamdi¹
¹Dept. of Computer Science & Engineering, College of CS & IT, AlBaha University, AlBaha, Saudi Arabia

Arnold Pears², Lelyzar Siregar³
²Uppsala Computing Education Research Group, UpCERG Uppsala University Uppsala, Sweden
³Faculty of Computer Science and IT, Universitas Sumatra Utara Medan, Indonesia

Abstract—This paper discusses the utility of the revised 2 factor study process questionnaire (R-SPQ-2F) to conduct a preliminary study of the study process of computer students at AlBaha University in the Kingdom of Saudi Arabia. The responses collected from 26 student volunteers are analysed to confirm the internal reliability of the instrument. Clustering of the responses by statistical construct reveals the main components of the students’ learning approach. We conclude that the R-SPQ-2F can be recommended for use as an instrument for assessing aspects of student learning outcomes and study processes as a part of efforts towards fulfilling academic accreditation requirements.

Keywords—study process; Learning approach, R-SPQ-2F

I. INTRODUCTION

The College of Computer Science and Information Technology (CoCSIT), AlBaha University is in the early plan of applying academic accreditation from ABET institution. In line with the plan, to achieve student outcome category of the ABET accreditation, a preliminary assessment of student learning outcome was conducted. The translation of the revised two-Factor Study Process Questionnaire (R-SPQ-2F) into Arabic was used [1]. The Arabic version was then distributed to Level 5th Computer Science students. A total of 26 students voluntarily completed the questionnaire.

The exploratory factor analysis is used to reveal the main components of students’ learning approach.

II. RESEARCH-BASED LEARNING

The educational system in Saudi Arabia obliges the secondary school students to engage in ‘surface learning,’ in which there is reproduction of factual knowledge. They are under pressure to obtain very high marks to secure places in universities.

The quality of student learning is how students go about their learning and what they learn. The concept of surface versus deep learning is a key feature to the development of a self-directed learner. Surface learning means the acquisition of knowledge only with the external motivation of passing exams. However, deep learning involves the acquisition of knowledge and understanding of the underlying principles, mechanisms, critical thinking, analysis, and possible applications. Motivation in deep learning is described as internal, with self-satisfaction and ownership of learning as the main motivating factor for the learner. Surface and deep learning can coexist, depending on the factors that promote the learning style of the learner. Gibbs describes factors that contribute to deep learning as an integrated curriculum, the match between the assessment and objectives, intrinsic motivation, and a learner-centered educational environment.

The lecturer plays a vital role in this process by the nature of the tasks assigned and methods of assessment employed throughout the curriculum. The quality of teaching is determined by the teachers' approach to teaching, their perception of the teaching context and their level of understanding of the subject matter.

A. What do SPQ scores measure?

Students’ approaches to learning are conceived as forming part of the total system in which an educational event is located, as schematised in the Presage-Process-Product (3P) model (see Figure 1) [2]. In the 3P model, student factors, teaching context, on-task approaches to learning, and the learning outcomes, mutually interact, forming a dynamic system.

Figure 1. The 3P model of teaching and learning
Presage factors refer to what exists prior to engagement that affects learning. On the student side this include such factors as prior knowledge, ability, and their preferred approaches to learning; and on the side of the teaching context, the nature of the content being taught, methods of teaching and assessment, the institutional climate and procedures, and so on.

These factors interact to determine the on-going approach to a particular task, which in turn determines the outcome. However, as the reversible arrows show, each such factor affects every other factor, so that for instance the student’s preferred approach will adjust to the particular context and course being taught, and to the success or otherwise of the outcome [3].

B. The Revised Two Factor Study Process Questionnaire

The R-SPQ-2F is an instrument that can be used by teachers to evaluate the learning approaches of students. It consists of 20 items that assess the deep and surface learning approaches. A five-point Likert scale is used to evaluate the learning approaches (1 = ‘the item is never or only rarely true of me’ to 5 = ‘the item is always or almost always true of me’) [4].

The Arabic version of the R-SPQ-2F used in this research was produced and validated by Munshi et al. [1] for use in teaching and learning evaluations at the high school graduates applying for a place in the medical program at King Fahad Medical City. A comparison of the English and Arabic versions was also conducted by the authors and other Arabic speaking colleagues at Al Baha University in December 2014, prior to the commencement of the current study.

C. Hypothesised model

The model used in this paper looks at the structure of the complete instrument from the items level. The model consists of the four sub-scales formulated as latent constructs with their corresponding five items as indicators. The relationship between the motive and strategy sub-scale are shown as a correlation, which in structural equation modelling terms is a more general case than combining them into a single higher order factor [5]. These two higher order factors are then hypothesised as being negatively correlated since deep and surface approaches are envisaged as dichotomous. The hypothesised model is shown in Figure 2, though to avoid duplication, the diagram includes the standardised path estimates and error terms resulting from the testing of the model. Variables in circles are latent constructs and variables in square are observed variables.

III. RESULTS AND DISCUSSION

A confirmatory factor analysis of the pilot data (n=35) was not considered to be meaningful to compute, given that the number of samples collected in the pilot study was so small.

However, Chronbach Alpha was computed for an assumed two-factor model, based on the factors and sub-scales identified by Biggs et al. [4]. Alpha was computed for both the Surface Approach (SA) and Deep Approach (DA) constructs, as well as for the sub-scales Deep Motive (DM), Deep Strategy (DS), Surface Motive (SM) and Surface Strategy (SS). The corresponding values are given in Table 1.

<table>
<thead>
<tr>
<th>Scale</th>
<th>DM</th>
<th>DS</th>
<th>SM</th>
<th>SS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alpha</td>
<td>0.73</td>
<td>0.41</td>
<td>0.59</td>
<td>0.35</td>
</tr>
<tr>
<td>Combined</td>
<td>0.78</td>
<td>0.68</td>
<td></td>
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</tr>
</tbody>
</table>

DM= Deep Motive, DS= Deep Strategy
SM= Surface Motive, SS= Surface Strategy

From this analysis we conclude that internal consistency can be confirmed for the two major factors, and for the Deep Motive sub-scale. The lack of internal consistency in the responses on the other sub-scales raises questions about their reliability and applicability. We will investigate this further using both Exploratory and Confirmatory Factor Analysis during 2015 as larger data sets become available.

To obtain a profile of the learning approach of the student cohort as a whole the mean and standard deviation for the pilot student sample (n=35) on the Deep and Surface scales of the SPQ was computed, the results are shown in Table 2.
There is no statistically significant preference for a deep or surface study approach observable in the data collected in the pilot study, as can be seen from the results presented in table 2.

This result is in stark contrast with our observations regarding teaching and assessment norms at AlBaha University. Teaching and assessment practice typically emphasises memorisation of material on lecture slides, and assessment practices emphasise use of multiple choice quiz questions and written examinations. This type of learning environment has been linked in Western higher education literature to increased student focus on surface learning approaches.

Our observations lead us to hypothesise that there might be a significant emphasis in the student learning approach on memorisation of material, and ability to reproduce facts that had been presented by teachers (a surface learning approach). However, this hypothesis is not supported by the results of the pilot study.

There are several possible explanations for the blended study process orientation observed in the student population surveyed in this pilot study.

1. The student population may have a strong intrinsic focus on understanding and personal responsibility for learning. This orientation way outweigh the strategic advantage of surface study approaches for many students.

2. The impact of the study environment on students is inconsistent with the assumptions upon which the R-SPQ-2F is built. This has been demonstrated in regard to surface and deep learning behaviour in other contexts, in particular the early deep and surface learning work of Watkins, Biggs, Marton and colleagues in Hong Kong and China.

Whatever the underlying explanation, this study has raised a number of very interesting questions about the study process and motivations of the pilot group. We intend to collect data from a much larger scale during the 2015 academic year for cohorts of students in both Computer Science and Computer Engineering programmes. We will also collect data from both male and female student sections.

### Table 2.

<table>
<thead>
<tr>
<th>Scale</th>
<th>Deep</th>
<th>Surface</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>2.87</td>
<td>2.86</td>
</tr>
<tr>
<td>SDev</td>
<td>0.76</td>
<td>0.67</td>
</tr>
</tbody>
</table>

IV. CONCLUSION

Our investigation of student approaches to their studies at AlBaha University in the Kingdom of Saudi Arabia shows that student study process is fairly evenly distributed, with the cohort showing no overall predisposition for either a deep or surface approach.

The student approach to study was measured by an Arabic language version of the revised two factor Study Process Questionnaire. Our pilot study raises several other questions.

Does the R-SPQ-2F accurately capture student study habits and preferences in the Saudi Arabian socio-cultural context? Further, does the absence of any dominant trend imply that teaching practices do not influence student's choice of approach to their studies?

To investigate these questions more fully we will collect data from a much larger student cohort during the Spring of 2015. Following this we will conduct exploratory factor analysis (EFA) and confirmatory factor analysis on the R-SPQ-2F Arabic language survey to explore its reliability and validity. We will also interview students to gain more insight into their study practices, expectations, and perceptions of the demands of their study environment and teachers.

REFERENCES


Integrating International Students into CS Programs

Neena Thota
Anders Berglund
Uppsala Computing Education Research Group
Department of Information Technology
Uppsala University, Uppsala, Sweden
Neena.Thota@it.uu.se; Anders.Berglund@it.uu.se

Abstract—In recent years there has been a rapid increase in the intake of international students at universities. Integrating foreign students into the disciplinary and social culture prevalent at the university is a challenging task. In this paper, first, we summarize the findings of three of our studies on the experiences of Chinese students studying computer science at the Department of Information Technology, Uppsala University, Sweden. Then, based on our findings we make recommendations on how to integrate international students into academic life at Computer Science departments. We focus on the program and course levels, and also at the level of individual students in their new social and cultural environment.

Keywords—international students; computer science; computer science education research

I. INTRODUCTION

Globalisation has led to universities playing key roles in the internationalisation of education [1]. International education programs broaden the educational experience of students [2] and initiate a process of learning and development for both students and universities.

Computer Science (CS) education at the university level generates disciplinary practices and knowledge producing activities that introduce a student to the epistemic culture of a scientific community [3]. The theories, concepts, and practices of CS vary across institutions and a key issue for universities is how international students learn CS concepts and assimilate practice.

Further, when students choose to study abroad, they bring with them the values and norms of their own cultural backgrounds. The interaction of disciplinary learning with cultural and sociocultural practices creates possibilities for new learning as well as problems for international students. An awareness of these issues is helpful and essential for universities that admit large numbers of international students.

The aim of our paper is to make recommendations for those institutions of higher education that have in recent years increased their intake of international student into their CS programs. In section 2, we summarize previously published work that acts as the foundation for our recommendations. We then proceed to state the recommendations for integrating international students into the academic and social cultures prevalent at a university (section 3). We conclude with an indication of our future work (section 4).

II. SUMMARY OF PREVIOUS WORK

In this section, we summarise the findings from three of our previous studies:

- Study 1: Experiences of Chinese students studying in the Master in Computer Science programme at Uppsala University in 2008 [4].
- Study 2: Experiences of Chinese students studying in the Sino-Swedish program at Uppsala University in 2012 [5].
- Study 3: Experiences of Chinese students studying in the Master in Computer Science programme and the Sino-Swedish program at Uppsala University in 2012 [6].

A. Study 1 (2008): Master in Computer Science programme

In the first study, email interview questions were sent to the 2008-2009 cohorts of Chinese students studying masters in CS at Uppsala University. Data was collected from nineteen students who responded. All students had previous academic background of studying CS in different universities in China and had spent 1 to 5 semesters studying at Uppsala. We asked 20 questions concerning the students’ opinion of the content of CS, of teaching and learning CS, their own studies in Uppsala University, and their personal development in Sweden. Using the phenomenographic perspective on learning [7], we created an analytical framework [8] to separate the what, how, why, and where aspects of learning from the descriptions given by the students.

The what aspect related to the practical versus theoretical nature of the CS programs in the two countries. The research driven approach of the CS courses at Uppsala University and the emphasis on theoretical knowledge rather than catering to market trends was highlighted. The how aspect revealed that students learn CS in Uppsala University through learning tasks (e.g. problem solving, questioning) and through class activities (e.g. collaborative group learning and discussion). The opportunity to demonstrate understanding and reasoning of learning was seen to link to increased motivation to learn. The why aspect revealed the students’ aims and motives in wanting to study abroad was related to the reputation of the university in CS education and their interest in improving their prospects for a future job. References to the country and culture showed that students also considered these factors when deciding where to study abroad. The where aspect indicated that by studying in Sweden, the students developed improvement in
systematic thinking, cross-cultural communication, and multicultural teamwork skills.

Living in Sweden meant learning to live independently in a foreign country and to adapt to western culture and life. An increase in confidence and self-reliance was noted. The changes also related to more tolerance of multi-culturalism and values/perspectives of others, as also an increasing understanding of universal fundamental rights. Nevertheless, leaving their own home country and parents meant coping with loneliness and helplessness. Learning to arrange the details of the daily life (accommodation shortage) and study schedule proved time consuming. Group work in class also proved problematic due to the differences in how Swedish and other non-Chinese students choose to express disagreement in discussions.

B. Study 2 (2012): Sino-Swedish program

The joint master programme in Computer Science and Software Engineering is collaboration between Department of Information Technology, Uppsala University, Uppsala, Sweden and School of Software Engineering, Tongji University, Shanghai, China. All students in the programme study in Sweden during their first year, and then continue their studies during a second year in China.

With the aim of exploring their experiences, we conducted focus group interviews with the Chinese students studying at Uppsala. We interviewed 7 students in two groups of 3 and 4. We asked specific questions about their experiences of learning and living in Sweden.

As in the previous study, the findings showed that students perceived the main differences in the academic programs as relating to an emphasis on theoretical concepts of computer science at Uppsala University and on practical skills at Tongji University. The students also noted that in Sweden, along with traditional lectures, learning was stimulated through class discussions, seminars, projects, presentations, labs, and open-ended questions in the final exams. Swedish students were seen as being more active in class discussions and able to make their own decisions about their majors.

In terms of personal development, the students felt that learning and living in multicultural Sweden had improved their job prospects and their communication skills in English. A growing awareness and appreciation of different cultures and the development of a worldview were also evident from the findings. The Chinese students also started taking ownership of the process of learning. Some of the challenges of living in Sweden were problems with accommodation and the high cost of living. Other difficulties dealt with social and cultural interactions in the classroom and group project work with other international students.

C. Study 3 (2012): Master in Computer Science programme and Sino-Swedish program

In 2012, we explored the variations within what Chinese students learn when they study CS at Uppsala University. We interviewed students from the 2011-2012 cohorts of Chinese students studying Masters in CS and in the Sino-Swedish programs by sending questions (and follow-up questions) by email. Nineteen students responded and similar to study 1, we asked them 25 questions concerning their opinion of the content of CS, of teaching and learning CS, their own studies in Uppsala University, and their personal development in Sweden. Using our previously defined framework [7], we identified the dimensions of variation in the what aspect of learning computer science.

As in previous studies, the focus of the programs was seen as emphasizing theoretical or practical aspects of studying computer science. The scope of the program was seen as a broad coverage of academic subjects preparing students for life in academia, research, and industry, or as a program that emphasized the development of practical skills useful mainly for jobs in industries. The learning outcomes were seen to depend on the way the teacher taught in English, or due to the nature of the assessments and assignments (labs and group work were considered challenging whereas exams and small projects were considered easy). The learning outcomes were also seen as dependent on individual prior knowledge and skills, on English language proficiency, and on ability for creative thinking.

The students gained awareness and understanding of new knowledge in CS, as well as an expanded awareness of the subject and deepening understanding of theoretical knowledge acquired earlier. Additionally, some developed lifelong skills such as academic research and problem solving skills. They saw that the theoretical and practical skills augured well for future jobs in the industry as well as in academia. Some gained the relational insight that CS is also about interaction, exploration, and personal meaning making.

III. DISCUSSION AND RECOMMENDATIONS

In this section, we discuss the combined findings from our studies, and based on our continuing work, we make recommendations for CS departments that wish to enhance the learning experiences of their international students. We do not make any claims at generalising from our qualitative studies. Instead, we offer the recommendations so that insights may be transferred to other relevant contexts or situations [9]. We focus on the program and course levels, and also at the level of individual students.

A. Program level

Our findings reveal that students’ perceptions of how they view CS can undergo a change depending on how the program is structured. Through the experience of studying in Sweden, the students were able to develop a richer way of seeing the phenomenon of learning CS. They were able to relate theory and practice and gain a deeper understanding of aspects they were unaware of earlier.

We are aware that international students might have previously experienced a CS program as focusing on theoretical concepts, or on practice skills, or on both. The students we interviewed were able to see the relevance of a program in terms of preparing for academia or research (theoretical focus) or as useful for future jobs in the industry (focus on practical skills). From the findings of study 1, we
know that students’ enrollment depends not only on the reputation of the university in CS education, but also on the interest in improving future job prospects. Explicitly clarifying the broad goals and scope of the university’s CS program is one way to expand the awareness of international students as to the relevance of the program to their lives.

Our findings also indicate that the students’ perceptions of the responsibility for their learning outcomes underwent a change when they experienced the changes in the program structures and reflected on their own skills and capabilities in new learning contexts. Opportunities for individual students to reflect on their learning should therefore be offered, so that they gain these relational insights.

B. Course level

In our studies, we found that Chinese students are likely to have limited exposure to a variety of teaching and learning strategies such as open-ended exercises, questioning in class, collaborative group projects, project presentations and seminars. Scaffolding with fading guidance [10] is one solution to introduce students to problem solving learning tasks through collaborative group work and discussions in class. Other techniques are pair programming and peer reviews of assignments and projects.

The students we interviewed considered the computing courses that they had not completed earlier as being “difficult”. To gauge prior knowledge of subject matter, questionnaires and tests can be used before tailoring course content to address gaps in knowledge. Online course material can be helpful for those students who are not proficient in the English language.

These Chinese students seemed more comfortable working with other students from their own country. Cultural differences that were reported related to expressing disagreement and questioning others in public. Course teachers and teaching assistants should encourage intercultural groups and be knowledgeable of issues that can arise within such groups due to different cultural backgrounds. Professional training courses to encourage cultural diversity can prepare teachers and tutors to communicate with international students.

C. Individual student level

The participants in our studies have mentioned issues with settling in and accepting and assimilating cultural differences. For Chinese students who are used to parental guidance, taking decisions and developing independence can be traumatic. Appointing mentors from within the student community helps in the process of social and cultural integration of international students. Community events and social gatherings enable an awareness of local culture and customs amongst students who have newly arrived in the country.

It would be valuable if university administration could ensure that accommodation is readily available so that a major source of anxiety for international students is lessened. Literature on how to access IT systems and other learning resources should be freely available. Another way to integrate international students into academic life is to offer courses to students to learn questioning strategies, academic writing, and research skills.

IV. Conclusions and Future Work

In this paper, we have made recommendations to CS departments for integrating international students into the academic and social culture prevailing at Uppsala University. Our recommendations are based on the findings of our three previous studies on the experiences of Chinese students studying at the Department of Information Technology, Uppsala University, Sweden. These findings and our recommendations can serve as a basis for discussions about how to improve the learning experiences of international students at other computer science departments and at other universities.

In the future, we intend to extend our research to students from other countries. Particularly, it would be rewarding to study the experiences of students from Saudi Arabia who choose to study at the Department of Information Technology, Uppsala University, Sweden. This would help the department to better understand and accommodate the Saudi students, and would broaden our understanding of the need of international students. In this way, we also hope to extend and nuance our recommendations on integration of international students into the university.

REFERENCES

Some Hints to Improve Teaching Quality in Computer Science Courses

Moez Krichen
Faculty of Computer Science and Information Technology
Al-Baha University Saudi Arabia
REDCAD Research Laboratory
University of Sfax Tunisia
Email: moez.krichen@redcad.org

Abstract—The main purpose of this paper is to provide interested readers with a collection of scientific references dealing with different aspects of improving the quality of teaching in computer science (CS). Several recommendations are extracted from these articles as well from my modest and short experience in teaching in this field.

I. INTRODUCTION

Teaching is a life mission. It is a valuable and honorable job. However, it is a huge responsibility and a heavy burden too. Higher education has been facing continuous changes due to the modern lifestyle of teenagers and new technologies which have entered all institutions. The relationship between students and professors has also changed. These changes have both positive and negative aspects. The situation is even more critical in the field of computer science teaching mainly for the following reasons:

- The speed at which computer technologies (both on software and hardware sides) are evolving is very high and most of the time teachers have very rare opportunities to update their skills and to synchronize their knowledge with new technologies.

- The emergence of new attractive high-level programming languages and techniques which are relatively easy to apprehend by even non-experts in the field make the access to fundamental and theoretical foundations more boring and difficult for students.

As a consequence, a continuous effort for updating and improving teaching methodologies is required both on individual and institutional levels.

In the remaining of this article we deal with the following aspects:

- Pedagogical skills required for teaching CS (Section II);

- Psychological aspects to take into account to motivate students during CS courses (Section III);

- How to deal with student lack of concentration during CS courses (Section IV);

- The importance of teaching autonomy for CS students (Section V);

- How to make students accept theoretical courses in CS (Section VI);

- The need to strengthen links between university and industry in the field of CS (Section VII);

- Special recommendations for CS teaching in transition countries (Section VIII);

- How to take gender into account in CS teaching (Section IX)

II. SCIENTIFIC AND TECHNICAL SKILLS ARE NOT ENOUGH TO BE A GOOD TEACHER

Nowadays, scientific and technical skills are not enough to be a good professor. One should acquire the art of communicating knowledge. Clearly, this is not an easy task. It comes with experience but also with training and readings related to pedagogy. Teamwork may be crucial at this level. That is, professors may need to collaborate with experts in different fields like psychology [29], [32] and sociology in order to identify new methodologies of teaching.

In [29], the author proposes a three step approach theory for teaching and learning. The three steps of the proposed theory are:

(i) work by the teacher prior to engagement with the student (e.g. needs assessment; diagnosis; mental ability including emotional intelligence);

(ii) work by the teacher with the student (e.g. module delivery, formative assessment);

(iii) work done by the teacher after engagement with the student (e.g. summative assessment, remedial planning).

It is vital for every teacher to keep updating and broadening his knowledge both in scientific, technical but also pedagogical aspects. For this reason, it is necessary to attend seminars and to read articles and even books in this field. Hopefully the literature is very rich with such materials about improving our talents in teaching computer science courses. Next is just a non-exhaustive list of such interesting documents [37], [25], [39], [28], [43]. Some of these documents are accessible on the web for free with no restriction. Several other references are cited in the remaining sections of this article as well.
III. Psychological Aspects to Take into Account to Motivate Students

I have been always wondering about the most efficient manners to give motivation to students. In this respect, my six years of experience as an assistant professor allowed me to discover that one solution to motivate students is to respect their way of thinking, to listen to their opinions and receive feedback from them. I am not perfect because I am the teacher. I like acting as a guide and not as dictator that controls every single step of his students. Obviously, if I act like a dictator, controller and all the time I am rejecting the ideas and opinions of my students, I am going to discourage them. As teachers, we need to be psychologists too in a way [19], [29], [32], we must not forget that students are human beings with personal necessities and feelings. Neither professors nor students are robots. The relationship between professors and students must rely on mutual respect, mutual understanding and on shared confidence. We must remember that our students may have problems and that they may be suffering from the pressure of modern life and that they have other courses to attend that they may like a bit more than the ones we are teaching.

IV. How to Deal with Student Lack of Concentration

One of the main problems I have now during theoretical courses is the lack of concentration of students. Unfortunately, one has to admit that with the emergence of internet [26], [2], [3], [35], facebook [40], [41], [21] and youtube[6] our students lost the capability to follow us keeping the same level of concentration even during a single hour of teaching. I am still looking for an efficient way to deal with this. Sometimes, I tell jokes to my students and I insert some funny pictures in my Slides to grab their attention and to keep them awake and to encourage some of my shy students to participate. Some recent studies have proved the feasibility of introducing some particular notions in computer science by means of educational games [15], [5], [42], [36], [33]. Obviously the use of modern infrastructures like online teaching platforms and e-learning techniques may help to solve this problem in a deep manner [45], [38], [27], [16], [30], [20].

V. Teaching Autonomy is the Solution to Follow up the Speed of Computer Science Evolution

In my view, one of the central ambitions of modern higher education is to teach students autonomy and how to be independent of teachers and to rely on their own skills [34]. This should prepare them to real life challenges. This may even give them the opportunity to become more skilled than their own teachers in a domain on which they have been working hardly. That is why I was usually trying to inform my students that they may have skills I do not have and that I may learn from them new interesting things.

VI. How to Make Students Accept and Understand Formal and Theoretical Courses

My students usually ask me such questions about purely theoretical courses I am teaching like “Language Theory and Compilation” [1], “Petri Nets” [7], “Formal Specification of Software” [44], “Model Driven Approaches” [22] and so on.

The answer I give is that, in the field on computer science and even in many other fields, there is a high complementarity between theoretical courses and practical ones. For this reason, I always try to keep in mind concrete examples illustrating this complementarity between theory and practice [4], [18], [8].

Moreover, I am doing my best to introduce theoretical notions in a simple manner using small examples and also to decompose big problems into smaller ones and solving them incrementally. One other way to attract students is to ask them questions and to give them exercises to solve letting them, in this way, contribute to the animation of the course.

VII. Strengthening Links Between University and Industry is Vital for Both Students and Teachers

One other important ambition of modern higher education systems is to establish a strong link between the university and the market. Naturally, our main vocation as professors, in our daily life, is to prepare our students to excel in their professional careers and to provide them with suitable tools to guarantee professional success.

Students usually ask legitimate questions about the reason of studying some particular courses and to which extent they will need these courses during their future professional life. For this reason we need to listen very carefully to our industrial partners and take advantages of their rich experience [12], [13], [14]. Clearly it is very important to listen to the opinion of students as well [17].

VIII. Special Recommendations for Computer Science Teaching in Transition Countries

Computer Science remains a good opportunity for transition countries to strengthen their economies. It is mainly based on intellectual efforts and expenses are quite limited. Thus a good income for the country may be guaranteed. As a result a special effort is to make to improve the quality of teaching of computer science courses in these countries [24], [31].

IX. How to Take Gender into Account in Computer Science Teaching

Nowadays female students seem to be more serious in all fields of teaching than male students. This is particularly true in the field of computer science teaching since the latter is purely intellectual and does not need any significant physical effort. For this reason a particular attention to the place of women in this field must be paid [23], [10], [11], [9].

X. Conclusion

According to my short experience in teaching, an important point to consider is that, in order to enhance student learning, initiatives should not always be on the teacher alone. Rather it should involve the whole institution and the learning environment. Teamwork between teachers is crucial, at this level, and periodic meetings between colleagues working in the same department or even in different departments or institutions to exchange ideas, to set goals and to plan courses is more than important and absolutely essential. I hope I will be frequently involved in such a process in the future inside my institution and even to collaborate with colleagues form other institutions on this topic.
Video Recorded Lectures as a Supplementary Resource in Teaching Electrical and Electronic Circuits: Students’ Perception and Instructor’s Insights

Ismat Aldmour
Department of Computer Engineering and Science
AlBaha University
AlBaha, Saudi Arabia
e-mail: iaaldmour@bu.edu.sa

Abstract— Video recording of active classroom lectures in two courses; electric circuits II and Microelectronics I were made available to third-year computer engineering classes for use as a supplementary resource. The videos were recorded and edited by the instructor himself using special video software. Lectures were conducted using smart board and a smart board software. This technique was found to appeal to computer engineering students and was shown to be effective regardless of a student’s academic level. Students resorted to this resource in reviewing the material, in solving homework assignments, and in preparing for the exams. Based on students’ feedback using a survey questionnaire and the instructor’s notes, the videos proved to be as a valuable resource that can support the traditional in-classroom instruction. It was also found to be effective in overcoming some English related obstacles to teaching-learning process such as difficulties in notes taking, difficulties in text book review and difficulties in dealing with English terms.

Keywords- computer engineering; video recorded lectures; multimedia learning

I. BACKGROUND

Using videos as a supplementary resource or as the basic media for conducting the teaching-learning process, e.g. in instructional television or open universities, has been around for some long time and it has been boosted by the ease of distributing the media over the internet and Web 2.0 tools. Advantages of using videos in education in general and in engineering education in particular include lowering costs and improved students satisfactions and motivation [1], improved effectiveness as a learning tool [2] and providing equal opportunities for both students with disabilities and normal students [3]. Short video clips can be part of a bigger package that include other multimedia tools such as texts, hyperlinks, pictures and animations. An example is the web-based multimedia labware for an environmental engineering laboratory [4].

Using videos in the teaching-learning process can take different forms, demonstration videos, narrative videos and recorded lecture sessions [5]. Demonstration videos serve two purposes; viewing procedures that otherwise are not available to students or recording students’ performance for feedback purposes [5]. Narrative videos are commonly used in the learning process of a language, offering a unique communicative and cultural context. Finally, video recorded lectures are a remnant of instructional television in which instructors deliver subject matter as they do in class [5].

Regardless of the debate in [5] or other literature sources, about the advantages and disadvantages of this type of video, recorded classroom lectures that are made available to intended students or even made public on the internet is a current trend undertaken by many universities through their instructional technology departments or even by individual academics. The internet is full of videos of such kind from universities in the USA, Europe and other countries and in different subjects. However, it is noticeable that not many of such videos are available from universities in Arab countries. This is a gap that needs real work to be filled in before it expands more.

The situation in AlBaha university, and in particular, in teaching courses to computer engineering students calls for innovation in teaching-learning methodologies, especially using technological tools such as recorded classroom lectures as a supplementary resource. The author, was the instructor during the last semester (2014/2015) of two courses; electric circuits II and Microelectronics I which are taught to the same group of 14 students. The instructor has experienced teaching the same group other courses (Circuits I and Numerical methods in C) in past semesters. He also has about five years of experience in teaching students in AlBaha university. General notes on students of AlBaha university and the computer engineering students in particular include the difficulty to read in text books due to many reasons including weakness in English. They are used to summaries and request power point slides as primary resource for reviewing. They also lack the capability of taking effective lecture notes. Again this can be attributed to many reasons including English. This situation makes achieving an effective teaching-learning a difficult target. On the other hand, the instructor noticed the fast and extensive reliance of the students on smart phones. He noticed that they are even using these smart phones to aid in notes taking by using the cameras of their phones to capture the lecture notes on the board. This gave me the idea that probably recording the lectures and making the video available to the students might help overcome these obstacles.

For that the classroom lectures starting the very beginning of the last semester were all recorded, edited and made available to the students through web tools such as Google Drive and Drop Box as well as through direct distribution of CDs. The videos were welcomed by the students. At the end of the semester a survey questionnaire was conducted. The objectives of the questionnaire are to assess the attitudes of the students toward this resource and the corresponding subjects, to assess and find out the extent and the ways they used and benefited from the videos, to assess the academic and other impacts of the recorded
lectures, and to assess the problems they faced when using the videos. The data obtained through the questionnaire were analyzed. The instructor experience and notes throughout the semester are presented and contrasted against the students views from the survey results. Finally, a conclusion is made about using this resource in teaching computer engineering courses.

II. OVERVIEW OF THE VIDEOS

The lectures in both courses, Microelectronics I and Electric Circuits II were recorded from the very first lecture using “Camtasia Studio” ver. 5 screen capturing software. This software enables screen capturing with audio. The speaker’s picture (a video in fact) can also be added (optionally) in a small box on top of the captured screen video (typically in the corner). It is called a picture-in-picture (PIP). The software enables typical editing of the video such as cut, copy and paste in addition to advanced editing capabilities like inserting titles screens, annotating the video with textual and graphical notes, subdividing the video into subsections and creating contents list. The software supports multiple screen capturing resolutions and partial or full screen capturing. It has conversion and video production capabilities in multiple video formats suitable for CD, web, email, IPOD and other formats. The lectures were conducted on a smart board and using smart board software which has multiple graphical capabilities and enables handwriting. The smart board software also enables importing power point slides on which the lecture can be based on. Nevertheless, most of the lectures were created from scratch in class time using the pen tool with some pre-inserted titles, graphs, pictures, text, etc to save lecture time.

III. THE QUESTIONNAIRE AND RESULTS

A questionnaire of 19 terms using 5 level-Likert scale was designed and conducted on all of the students in the two courses (same students in both courses). The questionnaire terms and its results are presented in Table 1. The questionnaire object to answer a number of questions. In the following the questions are presented together with the related terms and the results presented and commented.

- First, the questionnaire object to investigate the extent and the ways the students used this resource. Terms 1, 5, 6, and 7 try to answer this. From the results shown in the table and the calculated averages, which ranged from strongly-agree to agree, it can be easily concluded that the recorded videos were heavily used by the students in reviewing the material. It was also used as a resource to assist in solving homework problems, and to help preparing for the exams. The students assured that they used to repeat listening to the recorded videos or parts of it in order to make sure they understand the important points in the lecture. Hence, student centric learning is created which can help in overcoming the differences in academic backgrounds and capabilities between the students.

- The second objective is to assess the attitude of the students toward the recorded video lectures resource and the corresponding subjects themselves. Terms 8, 10, 11, 15, 16, 17 and 18 in the table try to answer this. From the results and the calculated averages, which also ranged from strongly agree to agree, it can be easily seen that the students developed positive attitudes toward the recorded videos and increased interest in the subjects themselves. They strongly believed that this resource will help them achieve higher grades. It also motivated them more to attend the formal classes. This last result was a relief to the instructor who was a bit worried that the recorded lectures might encourage absence. Another interesting result is that the students liked that the lectures being recorded live in the classes, as been the case, rather than recording passive lectures apart from the students. The students’ apparently were anxious to listen to their questions, contributions and the cases of funny occurrences. They strongly expressed their wish that the instructor keeps this practice in future courses and that other instructors resort to record their lectures as well.

- Thirdly, to assess the impacts the videos had on their academic level, understanding and readiness to exams. Terms 2, 3, 9, 13, 14 and 19 try to answer this. Note that term 3 tries to assess whether the recorded videos can have the negative impact of encouraging absence of the formal class. The students disagree on this statement which supports the result in the previous section that the recorded lectures even motivated them to attend the formal classes. Moreover, the students assured that the video lectures helped them in understanding the classes and the classes they missed. Other impacts are improved exams preparations. They also assured that the video lectures helped them understood Electric Circuits II better than Electric Circuit I of the previous semester taught with the same instructor (without recordings only). Another interesting implication is that the videos helped them in dealing with English terms in the courses. English is a difficulty facing our students. The courses are formally in English including text books and other course deliverables. However, the trend for a bilingual lecturer to lecture bilingualy; English and Arabic. It seems that this is not enough to overcome this difficulty and the recorded lectures gave more help in this regard. This is because the instructor usually gives Arabic translation to the terms or explain them in simple plain English as possible while the student has the opportunity to re-watch any part of the video multiple times.

Term 4 and 12 try to assess the difficulties the students faced in handling the video and its audio and video quality. They agreed on the good quality of the video and audio but they were neutral on the difficulties they faced. Regarding this last point, the instructor himself faced some difficulties at some stages as he is not specialized in instructional technologies with no support whatever in this regard from the university. I believe these difficulties reflected back on the students experience when handling the videos.
Table 1: Questionnaire and its results.

<table>
<thead>
<tr>
<th>#</th>
<th>Question</th>
<th>Str. Agree (SA)</th>
<th>Agree (A)</th>
<th>Neutral (N)</th>
<th>Disagree (D)</th>
<th>Str. Disagree (SD)</th>
<th>Avg. Scale</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>I listened to the video lectures in the two courses a lot</td>
<td>7</td>
<td>5</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>4.37 SA</td>
</tr>
<tr>
<td>2</td>
<td>The video lectures helped me in understanding the classes I missed</td>
<td>10</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>4.71 SA</td>
</tr>
<tr>
<td>3</td>
<td>The video lectures encouraged me to be absent from classes as the lecture is recorded</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>7</td>
<td>3</td>
<td>2.29 D</td>
</tr>
<tr>
<td>4</td>
<td>I experienced no problems or difficulties in running the videos and similar issues</td>
<td>1</td>
<td>2</td>
<td>10</td>
<td>1</td>
<td>0</td>
<td>3.21 N</td>
</tr>
<tr>
<td>5</td>
<td>I used to re-watch the recorded lecture or parts of it to make sure I understood the ideas within it</td>
<td>7</td>
<td>4</td>
<td>1</td>
<td>2</td>
<td>0</td>
<td>4.14 A</td>
</tr>
<tr>
<td>6</td>
<td>I resorted to the video lectures when attempting the homework assignments.</td>
<td>4</td>
<td>7</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>4.00 A</td>
</tr>
<tr>
<td>7</td>
<td>I resorted to the video lectures when preparing for the exams</td>
<td>6</td>
<td>8</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>4.43 SA</td>
</tr>
<tr>
<td>8</td>
<td>The video lectures increased my interest in the subjects</td>
<td>6</td>
<td>7</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>4.36 SA</td>
</tr>
<tr>
<td>9</td>
<td>The video lectures increased my level of understanding of the subjects</td>
<td>7</td>
<td>4</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>4.29 SA</td>
</tr>
<tr>
<td>10</td>
<td>I used to be anxious to the videos and the students contributions especially funny ones</td>
<td>6</td>
<td>4</td>
<td>3</td>
<td>0</td>
<td>1</td>
<td>4.00 A</td>
</tr>
<tr>
<td>11</td>
<td>I believe that recording active lectures (with students contributions) is more beneficial than passive lectures (with no students)</td>
<td>8</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>4.36 SA</td>
</tr>
<tr>
<td>12</td>
<td>The quality of the recoded video and audio was appropriate</td>
<td>3</td>
<td>6</td>
<td>5</td>
<td>0</td>
<td>0</td>
<td>3.86 A</td>
</tr>
<tr>
<td>13</td>
<td>I understood, with recordings help, Electric Circuits II better than Electric Circuit I of the previous semester (without recordings)</td>
<td>5</td>
<td>8</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>4.29 SA</td>
</tr>
<tr>
<td>14</td>
<td>The video lectures helped me in dealing with English terms</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>0</td>
<td>3.86 A</td>
</tr>
<tr>
<td>15</td>
<td>I wish that the instructor keeps this practice of recording lectures in future classes with him</td>
<td>12</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>4.86 SA</td>
</tr>
<tr>
<td>16</td>
<td>I wish that other instructors resort to record their lectures as well</td>
<td>10</td>
<td>2</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>4.57 SA</td>
</tr>
<tr>
<td>17</td>
<td>I believe that the video lectures will help me achieve higher grades</td>
<td>4</td>
<td>5</td>
<td>4</td>
<td>1</td>
<td>0</td>
<td>3.86 A</td>
</tr>
<tr>
<td>18</td>
<td>The video lectures contributed to being more anxious to attend the class lectures</td>
<td>4</td>
<td>5</td>
<td>4</td>
<td>1</td>
<td>0</td>
<td>3.86 A</td>
</tr>
<tr>
<td>19</td>
<td>The video lectures improved my exams preparations</td>
<td>7</td>
<td>7</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>4.50 SA</td>
</tr>
</tbody>
</table>
IV. INSTRUCTOR’S INSIGHTS

The positive results of the questionnaire in the previous section will be discussed here in light of the instructor’s notes and experiences during this experiment.

To the best of the instructor’s knowledge, this might be the first of a kind in AlBaha university and for sure the first time my students been to this. This might gave it greater opportunity to succeed as something new. Add to this is that the students’ experience with the same instructor in past engineering courses whereby whenever a student looses certain startup lectures or important joints in the concepts throughout the course might derail him totally from being capable of follow up with the more advanced concepts. For that, I believe the videos helped them to re-catch with others whenever they need. Combined to this, some offline videos (prepared by the instructor at home) helped the less capable students of weaker backgrounds to catch up with the rest. These offline videos were designed to tackle some fundamental concepts that are not core of the present courses, nevertheless are very essential. For example, the instructor prepared a video tutorial on complex numbers and conversion between polar, rectangular and exponential formats. These are essential to progress through Electric Circuits II in AC circuits analysis.

Moreover, the instructor noted that the excitement and the thrill whenever some funny answer or comment by a student occur. Even more excitement in these cases due to the fact that this case is captured and will be viewed again and again. Hence, upon editing, these were usually kept in order to motivate more reviewing the videos. In editing, only long breaks in lecturing due to unforeseen reasons difficulties with the smart board are removed to save students’ time. In some lectures the instructor’s picture was not captured by mistake. Hence, no PIP. The students asked for the PIP to be included all the time. This can be explained on the basis that the instructor’s PIP might convey messages through his body language which can assist understanding.

To be frank, as instructor, I was not so sure of the extent of the benefits of the videos. A number of signals assured me of the possible advantages which made me more keen in perfecting the process. For example, I noticed that the students were very keen to remind me to start the video capturing whenever I forget. I also noticed that the students’ attention increases and side talks decrease at video capturing start-up. Moreover, they were more alert and disciplined in this semester than in previous semesters. In one lecture where the laptop battery ran out of charge, I found that a number of students were happy to use their smart phones’ cameras to capture the lecture which continued using ink pens and a white board. Also, I noticed that some of the students were contending for front seats, a phenomena never noticed before. They also told me that they asked some other instructors to record their lectures as well.

V. CONCLUSION

In this experiment, the instructor captured his classes in computer engineering and made them available as offline/online videos to be used as a supplementary resource. It is found that this resource was positively received by the students. It also impacted their attitudes positively toward the subjects themselves. The lectures were actively captured in the formal class with students participation which motivated more the students to watch the videos. The captured lectures helped the students in reviewing, home works solving and exams preparations. This created a student centric learning environment that helped overcoming the differences between the students in academic levels and capabilities. It also helped them in overcoming some of our students difficulties such as the difficulties when reviewing using text books, the difficulties in notes taking and other English related difficulties.

Contrary to expectations, the recorded lectures motivated more the students to attend the formal classes. In summary the recorded videos acted as a complimentary but essential resource for the computer engineering students this semester.

REFERENCES


Learning to program
A discussion on the interplay of theory and practice

Anders Berglund
Uppsala Computing Education Research Group, UpCERG
Uppsala University
Uppsala, Sweden
Anders.Berglund@it.uu.se

Anna Eckerdal
Uppsala Computing Education Research Group, UpCERG
Uppsala University
Uppsala, Sweden
Anna.Eckerdal@it.uu.se

Abstract—In this paper we discuss an ongoing research project on learning to program and present some insights. The project aims to reveal the complex interplay between the learning of theory and the learning of practice, both of which are needed, for learning to program. We unfold certain patterns in how the interaction between the two takes place, and draw some preliminary conclusions for teaching relevant in a Western culture. As learning and teaching of computer science, as well as computer science itself, is culturally situated, we argue that similar research, focusing on how collaborating students, learning about the discipline per se, ought to be performed in the Kingdom of Saudi Arabia.

Keywords—Learning to program, theory and practice, phenomenography

I. IT IS HARD TO LEARN TO PROGRAM

Learning to program is a complex task for a student; likewise it is hard for an academic to teach introductory programming courses. There is much that a beginning student needs to learn before she or he can design and write her or his first programme. This paper presents insights from an ongoing project on how students, who work together, learn programming. The project aims to reveal the roles of theory and practice in the students learning and how these two entities interact in a whole [1-4].

II. IT IS HARD TO LEARN TO PROGRAM – A BRIEF LITERATURE OVERVIEW

It is hard to learn to program. This statement is true for most students, at least in a Western context.

Evidence are plentiful: Whenever (Western) academics, who teach introductory programming courses, meet they tend to discuss teaching and learning of their courses, and often worry about poor results on exams and about their nagging feeling that many of students, despite obtaining a passing grade, have not a “programming thinking”.

Besides this strong anecdotal evidence, much research has investigated different aspects of introductory programming courses. A series of papers compares learning, results etc. at different institutions in various Western countries, with the intention of seeing outside the individual teacher and her or his specific classroom. McCracken, et al. [5] argue that many students, despite passing grades, cannot solve simple programming assignments, while Lister, et al. [6] demonstrate that even a seemingly simpler task, to read programs, could pose difficulties to a large set of students. Similar problems and similar results, when it comes to design are shown by Eckerdal et al. [7]. Other studies have explored dropout rates (eg.[8], and [9]).

Despite the many attempts to improve teaching and learning, the underlying problems still remain. A set of publications, dominating at several conferences, and possibly even representing the totally largest number globally, tells about a specific method or a specific change made by an individual teacher (or a small group of teachers). As the teacher normally is enthusiastic about his subject, and believes in his changes, the students come to like her or his teaching. As a consequence, their results are often good for this course, given by this teacher. These papers, often referred to Marco Polo papers [10], can serve as a source of inspiration for other teachers, but do not offer any rigorous, research-based insights in how the problems could be tackled.

Certainly, research-based attempts have been made to tackle the situation. Technology has been used, for example manifested in different learning environments for Java, created with the intent to be friendly for beginners (eg. [11]). Other efforts focus on pedagogy, for example through pair-programming (eg. [12]), or on the effects of the social learning environment (eg. [13]).

A strand of the research on introductory programming aims to reveal how students understand and learn about programming and computer science. A cognitive research approach has for a long time been dominating, well summarized in [14]. Phenomenographic research [15], with its experiential perspective, studies the relationship between the learner and that which she or he tries to learn (here programming) has grown in importance (eg.[16]). The aim of this strand of research is to offer intellectual tools to the teacher to better understand how her or his students learn programming and through these insights to become a better teacher [17].

Despite the research presented in the previous paragraphs, still very few projects exist that focus on how collaborating students learn the subject area per se, when working in groups. Certainly work is done on group work (eg.[18]), but the
literature tends to focus on how a group work, and on the conditions for a group to work in a fruitful way, not on how phenomena in the subject area per se is jointly understood and developed in a team. Of a particular interest in this line of thought is the work of Ingerman and Berge [19], where he unfolds how physics students jointly learn and understand physics during lab sessions.

III. LEARNING THEORY AND PRACTICE IN PROGRAMMING EDUCATION

The T-PIPE project [1-3] studies the different roles of theory and practice, and their complex interaction, when students work in labs. Data is collected through video recordings of the students’ collaboration and is further analysed in a framework based in the phenomenographic theory of learning [15]. The project is based in Sweden.

As the project is on-going, this paper will present some current observations, based on an example, which is further elaborated in [4].

In an example, the students are supposed to write an if-statement in a method. When reading the supporting on-line document required for the task, they realize that they do know neither the syntax nor the semantics of curly brackets in Java. It is not until the students do something in practice, here they start to write an if-else-statement, that they notice a variation between their own code and the code in the examples. In the practice the students open up a variation so that they become aware of a gap in their understanding; they do not know the syntax and semantics of curly brackets in Java. When the students notice the gap they try to fill it. A complex movement between practice-oriented and theory-oriented actions follows. The pattern we see is:

- In the practice students notice variation, often created by the students themselves, which makes them becoming aware of a gap in their understanding. The practice thus seems to strengthen and direct students’ attention, through variation, to such gaps and thus opens for learning.

Another observation from this example is how the students go about trying to fill the gap. Situations with attempts to connect to previous knowledge are discussed by [20]. The authors write: “In order to fill the gap, relations have to be created between what the students already know and what is new in the situation.” (p. 152). The pattern that we see here and elsewhere in our data indicates that the attempt to fill a gap in programming might often follow a certain pattern:

- Student often first focus on syntax and how to do in practice. If they do not succeed, a theoretical discussion may start where the focus shifts to previous knowledge and whether this can contribute to filling the gap. Finally, if this attempt did not succeed, a continued theoretical discussion on what is new in the situation, or practical attempt, may follow.

An initial practice-oriented action, which can be characterized as for example “we do as we did in the previous exercise’-thinking, or ‘this is what the lab instruction says we should do’-thinking, or ‘I just happened randomly do this’, can trigger a need for understanding why, or why not, it should be done in this particular way. A theory-oriented discussion, which in our data is often focused on semantics, may follow to resolve the problem. When the students seem content with their explanation, or if they cannot come further, they continue with a practice-oriented action. Again, the practice might make the students aware of a gap in their understanding which leads to a theory-oriented discussion. Thus, we can follow a wave, or a movement forward in the learning process, which alters between practice-oriented actions and theory-oriented reflections, but where the practice-oriented actions frequently, but not always, seem to be the initial triggers of the movement. This may be because the students’ own practice creates variation, which helps them discover gaps in their knowledge/understanding.

Already before this project started we were aware of that both theory and practice were needed for a good learning of programming. But how closely connected these two facets are, to what extent they support each other and the whole, and how many ways in which they can interact, has only became visible to us as a result of this research project.

IV. FUTURE RESEARCH DIRECTIONS

Universities are a part of the globalisation. They belong to the local community in which they are situated, at the same time as they are heavily influenced by the cultural and social background of teachers and students and as they carry a culture of their own [21, 22]. Each subject area, as computer science, also brings its own sets of values and norms.

At the same time the discipline of computer science has its clear global character. The artefacts (for example computer, programs, and tools) are of the same brands at virtually all places on earth. Moreover, the English language is dominating and functions as a norm.

Cultural differences per se are widely researched; here possible Hofstede’s work, [23], is the most wide-spread. However, the link between the student’s cultures and their learning of their subject area is only little explored. The preliminary results from the on-going project by Thota and Berglund [24, 25] clearly indicate that students’ understanding on computer science is culturally situated, and thus, that learning of computer science varies over cultures and that teaching of the subject has to acknowledge the local culture in which the learning takes place.

We argue that meaningful research on students learning to program has to have a clear focus on the subject area, has to recognize that learning to a large extent is a social activity, and that it is culturally situated. Thus, research within teaching and learning of computer science, should take place in the local environment, and in collaboration with academics representing the subject area.
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Developing writing competence in IT-engineering students

Aletta Nylén
Department of Information Technology
Uppsala University
Uppsala, Sweden
aletta.nylen@it.uu.se

Abstract—The ability to present technical material and results in writing is a necessary competence for professional engineers. In this work, we present a three-year program aiming at developing writing competence in IT-engineering students at a Swedish university and preliminary results from running the program for two years. The program is a writing across the curriculum program where writing is practiced in the discipline, i.e., in regular information technology courses spread throughout the education. It has affected the attitude towards writing in both faculty and students resulting in students having a better understanding of how to write and why it matters.

Keywords—engineering education; professional competences; WAC;

I. INTRODUCTION

A professional engineer needs to be proficient in writing to be able to successfully e.g., pitch ideas, describe solutions and report results. Engineering students need to acquire the necessary writing skills and become acquainted with different types of texts during their education. The American Computing and Accreditation Commission (ABET) acknowledges this, e.g., in their general criteria for accrediting engineering technology programs [1] where “an ability to apply written, oral, and graphical communication in both technical and non-technical environments; and an ability to identify and use appropriate technical literature;” is listed as a required student outcome. The primary focus of this work is development of writing competency in higher education.

In the literature, there are two main approaches to teaching written communication – those where it is taught in dedicated courses [2] [3] and those based on writing across the curriculum (WAC) [4], where teaching is done in several courses throughout the education. Furthermore, writing can be taught in general language courses or in core subject courses, within the discipline (WID), where it can serve both to enhance learning and to practice professional activities [5].

In 2012, an initiative intended to strengthen the development of writing skills in IT engineering students was taken at Uppsala University. The initiative consists of a WAC/WID program and aims at supporting teachers in providing students with opportunities and conditions for writing skills development in computer science courses during the first three years of studies.

In this work, we share our experiences from the first two years of running the writing program. Some of these observations are specific to writing skills development while others can potentially apply to any program for professional skills development. In particular, most of this work is applicable to oral communication skills development.

II. BACKGROUND

The IT engineering program at Uppsala University, in likeness with other engineering programs, aim at educating students to become competent professionals. This means that the students do not only have to learn their core subject, they also have to develop a number of competencies that are essential to professionals. We refer to OECD [6] for a definition of a competency:

“A competency is more than just knowledge and skills. It involves the ability to meet complex demands, by drawing on and mobilizing psychosocial resources (including skills and attitudes) in a particular context.”

In this work, we focus on written communication ability for IT engineers, which OECD describes by

“the ability to communicate effectively is a competency that may draw on an individual’s knowledge of language, practical IT skills and attitudes towards those with whom he or she is communicating”.

To graduate from engineering programs at Uppsala University, the students must

“demonstrate ability in both national and international contexts, to, orally and in writing, in dialogue with different groups, clearly present and discuss their conclusions and the knowledge and arguments that form the basis for these.” [7]

This requires students to be skilled at writing within their subject, and to be able to adopt their texts to different situations and different audiences.

Study programs at Uppsala University, typically consist of a collection of courses, most of which are in the program’s core subject. Before 2012, isolated efforts of including professional skills development in courses in the IT engineering program,
had been done, but there had been no previous attempt to
structure this development across the education.

In early 2012, we explored the students’ view on the
writing education in the IT engineering program at that time,
by conducting a survey. The results are presented in detail in
[8]. The survey revealed a number of problem areas which the
communication program, that was subsequently developed, aim
at addressing.

The survey showed that writing practice is useful and that
we need to make sure that the students get more of it. It also
showed that not all students learn from practice alone, and for
that reason, feedback is very important. This result agrees with
what is written about the need for feedback in [9].

The students expressed a general feeling that writing is
important but their image of how it will be used in their future
profession was not clear. In order to get through to students
with the communication education that is provided, examples
of different kinds of professional communication is presented
during the education.

The survey revealed a discrepancy between the students’
perception of the quality of their writing and the teachers’
perception, the students rated themselves higher than the
teacher. Our interpretation of the result is that students rated
their general writing skills while teachers rated the students’
academic and discipline specific writing skills. This effect is
based in the students’ poor understanding of what writing in
their subject is and the result showed a need for improved
communication education.

III. BRIEF DESCRIPTION OF THE WRITING PROGRAM

The program aims at improving the written communication
skills of IT engineering students and primarily targets
communication concerning technical matters. It is implemented
in the first three years of the students’ education, which at
Uppsala University corresponds studies up to the level of the
Bachelor thesis. The program builds on the following
principles:

A. Frequent practice.

Students need reoccurring opportunities to work on
improving their communication skills. Students that are
exposed to different writing assignments throughout their
studies perceive improvement in writing skills [10].

B. Practice within the subject.

Skills achieved in dedicated courses are not necessarily
transferred to other contexts [11]. This means that general
language courses may not have the desired impact on the
students’ development in professional communication, which
is in their core subject. In addition to being ways of
communicating, writing, explaining and discussing are also
ways of learning [12] and help to form the professional identity
[13]. If the practice is not performed within the discipline,
these advantages will be lost.

C. Instructions, feedback and reflection.

Moore concludes that without proper instructions, guidance
and feedback, the only effect of writing assignments is to
reinforce bad writing [9]. He also argues that with proper
guidance, students show significant improvements both in
writing skills and in content knowledge. For oral presentations,
[14] report getting good skill development when using a
combination of practice, reflection and peer review. In [15], the
authors report that letting students reflect on their own work, in
addition to formal assessment advances the development of
professional competencies in general, why it is reasonable to
assume that this applies to development of writing competence.

D. Progression.

We believe that it is not only important that students
practice writing regularly and that they get feedback. In order
for the students to continue progressing over time, it is
important that the level of writing required in assignments
increases as the students mature. The feedback should also
meet students at their current level and promote further
development.

To ensure that IT engineering students at Uppsala
University are subject to reoccurring writing practice, writing
proficiency is a prioritized learning outcome for at least two
core subject courses each of the first three years of studies. To
encourage progressive development, learning outcomes for
writing at different course levels have been defined. A detailed
description and an analysis of the learning outcomes in relation
to competencies that are needed to fulfill them are presented in
[16].

Factors like restricted time, limited access to information
and the stressful situation makes assessing professional skills
through traditional exams difficult [17]. In this approach,
writing is therefore practiced and assessed in assignments,
where students have time to work on written material. The
students encounter a variety of kinds of writing assignments,
e.g., paper reviews, project proposals, lab reports, project
reports, etc. A categorization of student writing with particular
examples of assignments in each category is presented in [18].

<table>
<thead>
<tr>
<th>Year</th>
<th>Course</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Introduction to information technology</td>
</tr>
<tr>
<td>2</td>
<td>Program design and datastructures</td>
</tr>
<tr>
<td>3</td>
<td>Imperative and object-oriented programming methodology</td>
</tr>
<tr>
<td>3</td>
<td>Operating systems and multicore programming</td>
</tr>
<tr>
<td>3</td>
<td>Database design</td>
</tr>
<tr>
<td>3</td>
<td>Independent project in information engineering</td>
</tr>
</tbody>
</table>

IV. IMPLEMENTATION

This section describes the current state of the writing
program. It describes assignments in different courses and
initiatives taken to support teachers in this work. TABLE I.
presents the courses that were selected for writing practice and
how they are distributed over the first three years of studies. In
most of these courses, the teachers were supported in
constructing writing assignments. In some, assessment support was provided.

A. Introduction to academic writing in computer science

Introduction to Information Technology is the very first course in the IT engineering program. In this course, the main focus is to provide students with an understanding of what academic writing is and what is specific to writing in computer science. Effort is also put into exposing students to different types of texts that they are likely to encounter during their studies and in their future profession. The following activities were implemented in the course:

- Lectures on academic writing (in collaboration with the university’s writing center) and on computer science writing
- Reading technical reports and analyzing them with regard to structure, content, level of explanations, definitions, etc. The concept of scientific method is discussed.
- Writing definitions of computer science concepts and small project proposals. Oral feedback.
- Writing a report describing a fictive system. In addition to describing the technique, the report should cover societal, usability and ethical aspects. Written feedback focusing on text structure, language and referencing.

B. Describing their own work

The next step in the writing training takes place in the course Program Design and Data Structures, a programming course. The focus of this step is for students to practice describing their own work and the task is to write a report that describes a programming project undertaken in the course. At this course level, the students also start giving feedback on each other's texts. In this first course, feedback is given using a fairly simple form where the students provide feedback on a small number of predetermined aspects of the text. In preparation, the students are given a short lecture in which the basic principles of computer science academic writing is repeated and linked to the current task. Objectives and principles for giving and receiving feedback are also presented.

C. Different types of texts

In the course Operating Systems and Multicore Programming students undertake programming projects that are larger than in previous courses. They write a project proposal at the beginning of the project and a full project report at the end. One of the texts is written in Swedish and the other in English and writing is done in groups. The students give feedback on each other’s reports, but in this course they get a number of possible aspects, among which they choose a few to give feedback on. The university’s writing center contributes with a lecture, introducing the writing assignments, and additional feedback on the project proposal.

D. Theoretical content

In the course Database Design I, writing practice occurs in the form of a report that describes a computer lab that utilizes a large part of the theoretical content of the course. The task requires students to define and explain the concepts used, describe their database design, using theory to justify their design decisions and describe the implementation. The students give each other structured feedback that is commented and complimented by teachers.

E. Support for teachers

In cooperation with the university’s writing center, a workshop for teachers was organized. Topics that were discussed were the need for writing practice in courses, design of writing assignments, different ways of working with student writing and support is available for students and teachers. Teachers were given the opportunity to discuss their writing assignment designs with specialists from the writing center.

In many courses the student groups are large and thus teachers need assistance in assessing and giving feedback on written assignments. For that purpose, courses where students in year 3-5 are taught to do this have been organized. These students have then assisted teachers in courses, mainly by providing written feedback with regard to the text quality and not on the subject content.

V. Results

We will now discuss some preliminary results and observations from the first two years of the WAC/WID program.

A. Changing teachers’ attitudes towards teaching writing

An important part of this work has been to discuss writing and its role and place in the curriculum with teaching staff with the aim of ensuring that every single teacher has the ability and desire to contribute to developing the students’ writing competence. Previously, teaching the main course content was the only concern for many teachers and they neither taught writing nor commented on the quality of the students written communication in their courses. Previous literature [18] [19] report that IT faculty hesitate to grade writing since they do not have language expertise and since they consider evaluating writing to be a tedious task.

These discussions have resulted in more teachers being interested in introducing written assignments in their courses. They have also resulted in an increased demand for support regarding how to construct assignments and give feedback on writing.

B. Quality of student texts

It is too early to draw conclusions about how this work has affected the quality of student writing since no student group has gone through the whole 3-year program yet. We will present preliminary observations based on a random selection of reports by students in year 1 and 3 together with feedback given to the whole student body in courses in year 1 and, 3. All student texts and feedback are from courses given in the
academic year 2013-2014 and hence progression can only be observed by comparing courses within the same year.

The students in year 1 (Y1) follow the current writing program from the beginning of their studies. The students in year 3 (Y3) encountered only a fraction of the program in year 1, parts of it in year 2 and the full current program in year 3.

Y1 show an improvement in their ability to structure text in their second writing assignment compared to the first. Furthermore, when compared to Y3, they show better knowledge on how to structure scientific texts in IT and they appear to work more on their texts. A possible explanation is that Y1, to a greater extent than Y3, regard writing to be important and relevant to their education and future profession. This may be an effect of the changed attitude towards writing among teachers.

Studying texts written by students at different levels has given a deep insight into which difficulties are common and which are recurring. The difficulties found are likely to be local to the educational setting and form a rich source of information for teachers in the process of developing or refining instruction material to be used in that particular setting.

VI. CONCLUSION AND FUTURE WORK

We have described a model for professional skills development and how it has been implemented to develop writing skills in IT engineering students at Uppsala University. The approach has been successful in that it has engaged faculty in participating in developing students’ communication skills to a much larger extent. The model have not been used to a full extent long enough to present definitive results on how student performance is improved, but the preliminary impression is that students participating in the program develop an awareness of how writing in their discipline is done and the attitude that writing skills are important in their future profession.

When there are students that have participated in the whole writing program, its effect on the quality of student writing needs to be evaluated. In particular, methods for assessing writing skills progression needs to be developed and applied both to evaluate writing programs and for use in education.

ACKNOWLEDGMENT

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Impact of Mathematics in Computer Science Education

Bedine Kerim
Department of Computer Science
Collage of Computer Science and Information Technology
AlBaha University
AlBaha, KSA
bkerim@bu.edu.sa

Abstract— Mathematics has an impact on the development of computer science outcomes. In computer science, mathematics serves as a tool that allows us to reason about, model, and solve problems. To become successful professional computer scientists, students need to acquire mathematics competence during their education. In fact, the students' mathematics proficiency reflects on their outcomes in computer science education.

Keywords— Mathematics; computer science; computer education; problem solving; thinking

I. INTRODUCTION

The quality of computer science graduates is dependent, not only of the quality of their computer science education, but also on the quality of their mathematics education. The level of students' mathematics proficiency has a direct impact on how well they can develop their computer science skills.

For a computer scientist, mathematics is an essential problem-solving tool [1]. Mathematical methods are used for computations, mathematical models are used to structure problems and mathematical reasoning is used in the problem solving process [2].

This puts a requirement on computer science educations; in order to be successful in educating competent professionals, students must be supported in developing mathematical competence. They must learn mathematics both theoretically and how to use in computer science.

In this work, we investigate the impact of students’ knowledge of mathematics on their computer science studies. More precisely, our research questions are:

1. Is there an impact of students’ knowledge in mathematics on their ability to learn computer science?
2. What is the role of mathematics in the development of cognitive skills?

II. MATHEMATICAL COMPETENCE AND ITS IMPACT ON COMPUTER SCIENCE

Mogens Niss [2] describes mathematical competence as “the ability to understand, judge, do, and use mathematics in a variety of intra- and extra-mathematical contexts and situations in which mathematics plays or could play a role”. He identifies 8 mathematical competencies as major constituents of mathematical competence. These competencies are then divided into two groups. The first group consists of competencies related to the ability to ask and answer questions in and with mathematics. These are

1. Thinking mathematically (mastering mathematical modes of thought)
2. Posing and solving mathematical problems
3. Modeling mathematically
4. Reasoning mathematically

The second group consists of competencies related to the ability to deal with and manage mathematical language and tools:

1. Representing mathematical entities
2. Handling mathematical symbols and formalisms
3. Communicating in, with, and about mathematics
4. Making use of aids and tools (IT included)

We believe that proficiency in the competencies in the second group has a direct impact on computer science learning since these competencies are competences required in computer science, if the word mathematical is omitted. That is,
a computer scientist needs to be able to work with representations of entities, handle symbols and formalisms, communicate in and about computer science and make use of IT aids and tools.

The competencies in the first group are useful in computer science problem solving as well as in mathematical problem solving. A computer scientist needs to be able to pose questions in a way that can be handled within computer science, model problems and solutions, understand scope and limitations of concepts and statements in computer science. The relation between mathematical competencies and computer science is illustrated in Fig. 1.

If this reasoning is instead started from the computer science point of view, we find that the following components are needed to be able to solve computer science problems:

1. Basic knowledge in computer science
2. The ability to formulate the problem
3. The ability to construct the solution of a problem
4. The ability to apply a constructive solution of formal rules

All of these components have a counterpart in the mathematical competencies proposed in [2].

III. CASE STUDY AND ANALYSIS OF RESULTS

In order to investigate if mathematical competencies affect the learning in computer science, we have studied the results from a computer science course. The course, Design and analysis of algorithms and discrete structures, was given at the fourth level at the college of computer science at AlBaha University, Saudi Arabia. The exam was designed to identify competencies that could be further developed by learning mathematics. The skills tested and the results are shown in Table I.

<table>
<thead>
<tr>
<th>Skills</th>
<th>Percentage of Correct answers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transfer formal language to mathematical symbols</td>
<td>20%</td>
</tr>
<tr>
<td>Find necessary method to solve problem</td>
<td>5%</td>
</tr>
<tr>
<td>Ability to construct the problem solution</td>
<td>7%</td>
</tr>
</tbody>
</table>

Analysis of the results show that the students are weak in cognitive skills

IV. CONCLUSION

From the comparison of mathematical competence as described by Niss [2] and analysis of results from a computer science course given at AlBaha University, we conclude that

1. Mathematics have an impact on computer education
2. Learning mathematics, students acquire the skills of solving problems and formulating problems.

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A Study on Emerging Technologies in Computing Education

Mohammed Husamuddin¹, Fokrul A. Mazarbhuiya²
¹College of Science, ²College of Computer Science and IT
AlBaha University, AlBaha, KSA
mdhusamuddin@gmail.com
fokrul_2005@yahoo.com

Abstract

Technology and education have wandered many separate but rarely intersecting paths throughout the 20th Century. In the 21st Century, the convergence of cost effective computing and networking products, methodologies, and services is finally enabling more researchers and practitioners than ever before to explore innovative ways to use computer technologies to manage and enhance the teaching and learning experience. Technology has made its way into the classroom and is changing the way education is delivered. Emerging technologies have been heralded as providing the opportunities and affordances to transform education, learning and teaching. In this paper we discuss about the different emerging technologies in computing education.

Keywords and Phrases: Computing Education, Mobile Computing, Cloud Computing, MOOCS, 3-D printer, Games and Gamification

I. INTRODUCTION

Emerging technologies can be used in innovative ways to address issues of inequity and social exclusion. These emerging technologies could be used to create seamless and safe embedded interactive learning spaces across diverse contexts (Davidson & Goldberg, 2009; DeViney & Lewis, 2006; Hakkarainen, 2009; Henschke, 2010; Looi, 2010; Sharples et. al., 2007; Traxler, 2009)

Emerging technology is defined as a media that is coming into view, coming into existence, or coming to commonality. It is an innovative technology that is reshaping the nature of education. Computer and network based technologies now hold great potential for increasing the access to information as well as a means of promoting learning. Classrooms never before had such universal access to information. Technologies are transforming classrooms into more engaging, collaborative and productive learning environments in which instructions can be customized to student’s specific needs, interests and learning styles, It is also redefining the way educators teach as well as the role they serve- from being the sole source of information to being a guide, facilitator and coach in the learning process.

With the recent advancement in the education industry in Saudi Arabia, the use of computers in education has become relevant. Computers play a great role in helping students learn faster and they also increase the level of creativity of students because of the endless equations they present to a student. Recent innovations in information technologies are beginning to have an important impact on education. Technological innovation and advancements have brought about massive societal change. In comparison, technologies impacts on education, teaching and learning have been rather limited (Bull, Knezek, Roblyer, Schrum, & Thomson, 2005).

II. EMERGING TECHNOLOGIES

A. Cloud Computing

Nowadays, “Cloud Computing” is most discussed term in business and academic environment Because of the increasing popularity, many giant IT companies such as Microsoft, IBM, Google and

Cloud computing refers to computing facilities provided on demand, served over the Internet from shared data centers that exploit enormous economies of scale. Rather than purchasing a cluster of computers, finding space in your local lab, hiring an administrator, and then letting the facility sit idle when not needed, you can outsource your computing to remote facilities in the cloud, and pay only for what you use.

**Benefits**

Cloud computing is probably the most cost efficient method to use, maintain and upgrade. The process of backing up and recovering data is simplified since those now reside on the cloud and not on a physical device. Storing information in the cloud gives you almost unlimited storage capacity. Hence, you no more need to worry about running out of storage space. Once you register yourself in the cloud, you can access the information from anywhere, where there is an Internet connection. Lastly and most importantly, cloud computing gives you the advantage of quick deployment.

**Risk**

Though it is true that information and data on the cloud can be accessed anytime and from anywhere at all, there are times when this system can have some serious dysfunction. Security can also be a concern in the cloud, particularly if you manage confidential data like customer information. Making sure every existing tool, software and computer is compatible with the Web based service, platform or infrastructure. Storing information in the cloud could make your company vulnerable to external hack attacks and threats.

B. **Mobile Technology**

In a time where mobile internet traffic surpasses desktop traffic, mobile devices cannot be ignored in the field of education. Not surprising that educational apps are the second most downloaded category of mobile applications on iTunes. Since mobile devices are more affordable than most laptops, they are the first choice for educators. Staying connected while on the go are many---- Smart phones, tabs, Laptops and a wide range of other devices access the internet using cellular based hotspots and mobile broadband cards.

**Benefits**

Mobile technology gives easy access to information. Over the years; it has changed the way of communication. There has been significant improvement in the mobile technology. This has led to better efficient service. The mobile technologies have speeded up small and big companies. It is very cost efficient.

**Risk**

Mobile IT devices can expose valuable data to unauthorized people if the proper precautions are not taken to ensure that the devices, and the data they can access, are kept safe. Long use of mobile technology can also lead to health issues. Sometimes the network fluctuations can act as a barrier in accessing data. Huge data traffic can lead to slow accessing speed.

C. **MOOCs (Massively open online courses)**

Massively Open Online Courses have become increasingly popular and continue to grow rapidly over the last few years. Anyone with an internet connection in any part of the globe can learn pretty much any skill set at no cost. This method comes close to moving the classroom experience to an online activity. Its personalized approach has made it the most sought-after method to learn. In the past year, Massive Open Online Courses (MOOC) have emerged to be a major trend in the education space, witnessed by the rapid takeoff of online universities such as Coursera, Udacity, and EdX. Millions of online learners from all over the world are now studying science, engineering, and humanities.
subjects delivered by the world’s best professors, without having to pay expensive tuition or having to quit their full-time job.

Benefits

MOOCs encourage both staff and student to engage with each other. Students can argue on the philosophy of the course through visual speaking method. Even after completing the course, alumni can still stay with the institution by teaching a new batch, or by working in the backend process. MOOCs are designed to be extremely interactive. It uses all the interactive media available on the internet to engage students. The best thing about MOOCs is; it has given a new dimension to higher education. Courses that fall under this online learning are offered by some of the best institute with good online facilities and teaching faculty.

Risk

The major hurdle which is faced is the standardized and proper structure of the course. Generally, MOOCs don’t have proper set of learning objectives that can go well with all participants. Presently, there are thousands of students who take up MOOCs course through overseas universities, but there are only few who could complete the course entirely. Another major challenge is the different roles of instructor. Having a large number of participants also poses hurdle in communication between instructor and students. This is yet another problem which the user faces. As the entire course is offered online, both faculty and students have to rely on multimedia content. Lastly, the student’s performance cannot be assessed properly as there is always a chance of cheating.

D. Games and gamification

Games and game-like elements have begun to invade the real world. Gamification, defined as the use of game mechanics, dynamics, and frameworks to promote desired behaviors, has found its way into domains like marketing, politics, health and fitness, with analysts predicting that it will become a multi-billion dollar industry by 2015 (MacMillan, 2011). Some visionaries, like game designer Jesse Schell, envision a kind of gamepocalypse, a hypothetical future in which everything in daily life becomes gamified, from brushing one's teeth to exercise (Schell, 2010).

Benefits

With a gamification approach, you make routine tasks or learning a bit more enjoyable. Creates an “Engaged Learning Design”. The interaction in these games creates a better understanding for learners in regards to information tools. Gaming enhances the positive development of an individual. It also increases attention span and helps conquer fear.

Risk

Gamification may lead to health issues due to long sessions. It can make someone habituated towards gaming. It can also generate over confidence as it is not a real world and can lead to wastage of time. Sometimes the method of reaching the highest rank can become trivial as the only important aspect is reaching that superiority. This is a problem of the wrong motivation direction. The user is targeting their motivation towards being the best and not at seeing what the site has to offer.

E. 3-D Printing

Technologies that construct physical objects from three-dimensional (3D) digital content such as 3D modeling software, computer-aided design (CAD) tools, computer-aided tomography (CAT) and X-ray crystallography. Arguably the coolest piece of technology, the 3D printer is still a newbie when it comes to education. Prototyping and production tools are used by geology, anthropology and organic chemistry students. STARBASE, a Minnesota non-profit is using 3-D printing in their aerospace program where students plan a mission to Mars. More recently, Harvard University’s Semitic Museum used a 3-D scanner to assist in the archaeological restoration of an Egyptian artefact.

Benefits

3D printing enables quick production of prototypes or small-scale versions of the real object. This helps researchers and engineers plan the actual object and catch any design flaws that may affect quality and functionality. Since 3D printers can “print” products as and when needed, and does not cost more than
mass manufacturing, no expense on storage of goods is required. One of the biggest breakthroughs brought about by 3D printing technology would be in the field of medicine and organ replacement to be specific. 3D printing is also considered environment friendly since it produces less waste compared to other techniques.

Risk

The biggest possible disadvantage of 3D printing is counterfeiting or production of “Fake” stuff and the copyright issues arising due to it. At present, 3D printers have limitations when it comes to size of the objects created. If you give technology in the hands of people, there will always be a few who would use it for the wrong purposes. 3D printers can be used to scan and print I.D. and credit cards, car keys, as well as a multiplicity of other private belongings. The cost of buying a 3D printer still does not make its purchase by the average householder feasible.

III. CONCLUSION

The tendency of academia to embrace new technology for educational purposes is definitely a step in the right direction. Technology in the classroom benefits students in ways from lightening their textbook load to augmenting the traditional, centralized mode of teaching to allow for more interaction and creative interconnection. However, technology within the classroom shouldn’t be used to stand in for effective teaching methods or to completely bypass personal interaction in class. These emerging technologies can be very productive in the Kingdom of Saudi Arabia. Due to the scarcity of female faculty in the kingdom, these technologies can be helpful to teach the female students by the male faculty.

Technology in the college setting has proven to be useful and hugely beneficial in many cases, but it will always remain necessary to weigh the pros and cons to avoid using technology for technology’s sake.

IV. REFERENCES


Vision Seminars and Administration of University Education – A Case Study

Abstract—The deployment of new IT systems in an organisation is a critical phase. If the deployment fails, problems in the organization can remain for many years, even if the technical systems that are implemented are of a high quality. One main reason is that the focus has been on implementation of the technical system and not on the organisational changes and the new work processes. The purpose of the vision seminar process discussed here is to allow skilled professionals from the organization to participate in a series of seminars with the aim to specify the new work processes, necessary organisational changes and basic requirements for the new supportive IT systems. The visions, specifying the future work and its support systems, can be used as a basis for the deployment activities. It is e.g. important to base information, education and user support on how to perform the new work and not (only) on how to handle the new IT systems. In this paper we also present a case study, where the vision seminar process is applied in a project where a new system for the administration of student records for Swedish universities is developed.

Keywords—vision seminars; student record system; usability

I. INTRODUCTION

Deployment and introduction of IT systems is generally very difficult and the success levels are often low. The Ladok (footnote: The name Ladok comes from the Swedish abbreviation of “Local Electronic Data Processing Based Student Record System”) system is no exception. Often the IT systems launched are difficult to use, inefficient and the expected benefits of the implementation of the system are seldom reached (see for example DeLone, 2003). Nevertheless, while it is very difficult to introduce new systems, IT has become an integrated part of both work and leisure time and affects us in many different ways. The introduction of IT systems can, for example, increase dependence on hierarchy and bureaucracy, and also affect professional identities and established work procedures (see for example Eriksson-Zetterquist, 2009). Moreover, IT systems constitute a part of our work environment (Sandblad et al 2003), and can cause unhealthy amounts of stress if they do not support us effectively and enable us to work efficiently. In the light of this crucial relationship between IT systems, and the work they are designed to enable and support, it is surprising that many organisations still make the mistake of regarding the deployment of an IT system as an IT project, instead of as an organisational change project.

One of the many problems when introducing new IT systems is the lack of a clear vision describing the users’ needs and the requirements these needs impose on the system (Hardenberg et al, 2007a, 2007b). The problem of lacking such a vision is, unfortunately, reinforced in today’s dominant systems development process, Scrum (Lárusdóttir, 2013). Research has shown that users are only included during the development process for the purpose of giving informal feedback, and they are seldom offered the time and scaffolding needed to successfully express their ideas and needs (Cajander, 2013). DeLone and McLean (2003, 1992) stress in their model of information system success, among other things, the importance of understanding who receives the benefits of the system and the way in which these parties are assisted. In the vision seminar method used in this paper this is the core idea, and the process is designed to support us in creating this understanding.

This paper presents work in progress concerning the use of vision seminars in the development of a student record administration system (henceforth called the Ladok system) that will be used at a vast majority of Swedish universities. The vision seminar method is a process that has been developed by the HCI research group at the Department of Information Technology, Uppsala University, and has previously been used in numerous other contexts during more than 20 years, e.g. in health care, process and traffic control (see for example Hardenborg et al. (2007a, 2007b). In the vision seminar process we among other things document a series of user stories or "visions" told by user representatives of each of four different user groups that participated in the vision seminars.

The main contribution of the paper lies in presenting how the vision seminar process can be used and adapted to the university context. We describe how stakeholders, such as administrative staff, teachers, educational leaders and students, see the Ladok system developing in the future and demonstrate how insights gained from this process can be transferred to other university contexts.

The paper is structured as follows. First the background of the Ladok system is presented, as well as a short description of the vision seminar process. This is followed by a presentation of the visions presented by the four different user groups that participated in the vision seminars. Finally we discuss and
reflect upon our experiences from working with the vision seminars and suggest topics for further research in the area.

II. THE LADOK SYSTEM

The Ladok system has been deployed at 37 universities and colleges in Sweden and is set to have over 500,000 users by the end of 2017, making it one of the largest IT development projects in the country. The system itself is a complex, nationwide computer-based administration and documentation system, which is developed and owned by a consortium of Swedish universities. It has been designed to facilitate day-to-day administrative activities such as the monitoring of student attendance and study performance, issued degrees, and institutional compliance with legal requirements. The system can be used by all public universities and aims to support decentralised decision-making.

The heart of the Ladok system is a "mutual core", implemented identically on all installations (Paulsen, 2002), which consists of a repository of student records. Each institution that uses the system decides which part of the core it wishes to access and which additional features it wishes to integrate from a local level. Due to the size of its consortium, you could say that Ladok is the industry standard for student record systems in Sweden, and the system is used in almost all universities and colleges in the country. In addition to its administrative function, Ladok is also the main interface for institutional reporting to governmental agencies and bodies such as the Ministry of Education, the Student Loan Authority and Statistics Sweden.

![Fig. 1. Students doing affinity diagrams as a part of the vision seminar process.](image)

III. THE VISION SEMINAR PROCESS

During the vision seminar process, user representatives from the future user groups meet in a series of seminar events. On these occasions, users are guided through a process that scaffolds creative thinking in relation to the future, based on the current work processes of the users. The aim of the vision seminars is then to create a shared mutual understanding through visualisation and to visualize how the future work of different users will look like, including organisational aspects, work processes communications patterns and new IT systems which support this new work. This is then recorded in a “vision document”. The results from the vision seminars can therefore contribute significantly to the requirements elicitation process during systems development. The vision seminar process builds on the values of participatory design, which can be defined as cooperation, curiosity, creativity, empowerment and reflexivity (Steen, 2013).

In the case of the Ladok system, six senior lecturers, six heads of studies, six study administrators and six students participated in the vision seminar. The participants were volunteers from different departments at the university, and they did not get paid except for the student group who received cinema tickets. The process itself was planned and organized by three members of the department of information technology at Uppsala university.

Operationally, the vision seminar process consists of the following steps:

1) Preparation
2) Assembling the Work Group
3) Seminar Planning
4) Realization of the Vision Seminar Process
5) Creating Additional Input
6) Anchor the Results in the Organisation
7) Documentation

The seminar process is performed as a series of successive seminars, typically 4-8, where the vision of the future work is stepwise developed. It starts with analysing the present work and its problems and limitations. More and more mature visions are formulated during the following seminars. The time between the seminars is very important. It gives the practitioners time to reflect and come up with new ideas and the process leaders to document and analyse the evolving material. For a full account of how the vision seminar process works in practice, see Hardenborg et al (2007b). For further readings about the scientific contribution of the vision seminars, see Hardenborg (2007).

IV. VISIONS OF THE FUTURE

The vision seminar process results in the development of a set of requirements for the future system as well as some scenarios presenting how stakeholders see the operation of the system on a typical day at some specific time in the future (e.g. 2017). We list, below, some of the general requirements from all user groups and follow this by presenting a short scenario describing the student perspective.

All user representatives wanted a completely paperless process, i.e. a digitized workflow. A crucial point was that there should be no unnecessary steps in the process. However, this requires a full description of the workflow processes, which is not currently available. Users want to remove all routine tasks that are irrelevant for the quality of the education. However, it is crucial that the system supports the users working with student record administration, not controls them.
The idea of “process” needs to be at the core of the future system. It needs to be possible to follow a hypothetical case described from start to finish. All user groups want to be able to see clearly whereabouts their case is in the overall process, and who is expected to do what. This is necessary to enable the user to see the big picture and implement functionality such as alerts and reminders.

All user groups stressed the need for a single IT system, which would administer the various elements of the students' educational journey and be perceived as a single integrated system. The user groups strongly dislike having a large number of different systems. Recent studies of work at the university have shown that the tasks performed by many administrators require them to interact with 15-25 separate computer systems, which leads to a significant reduction in work efficiency. You should not have to sign in and out of different systems (as it works today). System support should also be continuous and of high quality - a requirement that was echoed by the student group who stressed the importance of a single-sign-on solution.

A. Some Important Aspects for the Administrators

Administrators need to have wide-ranging access to the system and to be able to amend data input by other users. Some in the group think this is especially important because there could be situations when students or teachers need help, as they may be inexperienced, temporary employed, international students etc. The administrators have an important service role and their current function could be compared to that of a spider in a web. Both the teacher group and the head of studies group stated that this role must be maintained and strengthened. Since it was clear that the study administrators often provided support to both teachers and students, and were required to answer questions on a wide range of issues, they needed to access and control all system processes.

B. Some Important Aspects for the Teachers and Educational Leaders

Study administration must be legally secure and quality assured. An integrated workflow reduces the risk that issues fall between the cracks or information disappears. Such an integrated workflow would simultaneously create conditions for a more qualitative work and provide better support for both overview of the process and division of labour. The ability to get this type of system overview of the study administrative process was deemed to be important. One should note that both the educational leaders and the teachers reacted negatively to the idea of having a new system built upon a concept of "self-service" (user autonomy). Both these groups wanted to be able to focus on their professional responsibility, and did not wish to increase their workload.

C. Some Important Aspects for the Students

From the students' perspective, “study administration” is an almost alien concept, as study administrative functions are not distinguished from other study related activities. For example, the process of pre-registering for an exam is not seen as something different from uploading a written assignment or access lecture notes.

The student wants to have some degree of responsibility for their administrative work. This requires both good and clear systems, from which they can receive help when necessary. A key concern is that study administrators must be able to have access to all relevant information in an integrated manner in order to help students in the best way. The students want to be able to receive adequate and correct help. They describe the entrance to student life as a critical phase where it is easy to become confused by the variety of educational and administrative demands. New concepts are numerous, and it is easy to become confused by, and lose oneself in, the different processes associated with the various stages of application, statement, admission, registration, account creation, permissions, etc.

"It is the start at the university that is heavy."

"It's always the same questions on the basic courses, no one understands what they are going to do."

"If it is hard for us, it is almost impossible for someone who is not used to computers."

One reason for this confusion is that processes and IT systems differ between departments, and even within departments. According to the student group, it is often easy as a new student, at least initially, to avoid using the study administration systems and instead rely on peers to stay updated.

At Uppsala University, lack of uniformity applies to almost all of the steps in the student administration process, which differ between departments and also at the level of the individual. Teachers can develop their own procedures to administer lectures or provide course materials. Information about what applies at a particular department, or for a specific course, is in many cases inadequate or difficult to find. Nevertheless, there are also examples of good practice, where departments make information available in a clear manner. This makes the lack such provision from other departments even more frustrating and incomprehensible.

D. A Scenario of Student Study Administration in 2017

Shortly after breakfast, Lina's mobile phone audibly requests her attention. The sound makes her jump and she knows immediately what the notification is about. There is a new message on the Student Portal. She opens her message that reads "New results have been registered." The exam has been graded! Nervously she accesses the Student Portal app. At the top of the page, it says "New Message". She opens the message. Approved! What a relief. Lina ticks the "Send by mail" box and verifies that the default address is correct. Hopefully she will have her exam result in her physical mailbox by tomorrow. She considers clicking on the "Accept results" right away, but decides that it is best to look at the exam first to see if there are any reasons to request a re-evaluation of the grading. That means it will take a few extra days before the results are reported to CSN, but it does not matter since this is handled quite quickly anyway.

“I wonder how it went for the others in the study group?” Lina clicks to enter the group's own page on the Student Portal. It is located within the dedicated course page, Spanish A, and is easy to access. She writes a message to the others to ask them how they did in the exam.

Lina thinks that the next step is to forward the good news to her mentor. She writes an email from the Student Portal's own webmail page, which she uses because it is easier and better looking than her usual email account accessed via Gmail. She remembers that only a
few years ago this was not the case and it was a pain to send emails this way.

In the email to her mentor she writes “Hooray, exam passed!”, and thanks her for all her help during the semester. Without the help of her mentor, this semester would have been much harder. At first Lina was hesitant to apply for a mentor as she had heard that the procedure used to be quite complicated. After googling it, she realised that it had become much easier to get one in recent years. Previously, the onus had been on the student to get in touch with the student coordinator for disabilities. But when Lina applied to the university last spring, she simply clicked on the box “Interested in extra support” in the online application form. When she was admitted, she received one email asking the kind of support in which she was interested with a tick box for options. When she answered, she was put in contact with a mentor, a student who was further ahead in Spanish and was good at structuring study time. Together, they planned Lina’s studies and set milestones. Lina remembered how difficult it was to manage this back in high school with her ADHD. She had agonised over starting and thanks her for all her help during the semester. Without the help of her mentor, this semester would have been much harder.

Lina’s mobile phone requests her attention again. She picks it up and reads a message from Hakim in the study group, which is displayed as a comment on her own message. Hakim has also passed the exam and suggests lunch at the Gotland student nation to celebrate.

Lina replies “Absolutamente amigo!”

V. DISCUSSION

It is notable that there are significant similarities between user responses and that the visions are mostly consistent between the three professional groups. The differences are more a matter of emphasis rather than conflict. One difference is in perspectives and concepts. Administrators are working with tuition and admission codes and have a specific terminology for this. Teachers are more naturally focused on the on-going courses and course instances. There is a potential for communication problems here but it is important that the system supports both groups.

The overall vision for the professionals is all about flexibility; the system must provide support study administration and not control it. The system needs to allow different approaches within an agreed set of limits. The professionals want to see most of the work as processes. This would facilitate the understanding of processes and where a certain process exists, support collaboration, meeting deadlines and contribute to higher educational quality together with greater levels of service for the student experience.

There is a clear conflict between the student’s need for a consistent and uniform system for the whole university, and the three professional group’s need to have a very flexible system.

One interesting finding in the vision seminar process is that there is a need for process descriptions in terms of work processes, skills, concepts. It is also necessary to have a discussion regarding work processes and also the amount of administrative work done in connection to the education at the university, and a discussion is needed about the amount of administration necessary in relation to quality of education.

All four participating groups are very positive about the work and results. They have asked for more feedback meetings with the student group to discuss the common vision. All participants hope that the work performed will contribute to the development of Ladok in a positive way.

Further work is needed on the integration of the findings of the vision seminars in the national system development project. We know from previous research that it is not easy to integrate these kinds of results in any systems development at large government organisations (Cajander, 2014). Moreover, more research is needed on the integration of vision seminars in the dominant systems development processes.

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Massive Open Online Courses (MOOCs): Lessons Learned from a Student’s Perspective

Virginia Grande
Department of Information Technology
Uppsala University
Uppsala, Sweden
virginia.grande@it.uu.se

Abstract—Massive Open Online Courses (MOOCs) are a current topic of discussion regarding their impact on education. This paper presents the lessons learned from the perspective of a student of this kind of course, having participated in different types of MOOCs. Experiences on topics such as assessment, collaboration and learning strategies are included here to contribute to the discussion.

Keywords— MOOCs; Massive Open Online Courses; lessons learned; student perspective

I. INTRODUCTION

Some believe that MOOCs will completely change the educational system, and that campus based education will become obsolete. Teaching in its traditional sense will not be needed, and students will be self directed learners crawling the internet for new knowledge. Proponents believe that new technologies have changed the very core of education, and after their introduction things will not be the same for neither students nor faculty. Others believe that MOOCs “will not transform education” and prefer to see MOOC platforms as “a social learning platform” [1].

MOOC stands for Massive Open Online Course. The definition of this term is, however, somehow blurry, especially now that new providers are offering different implementations of the concept. We offer a definition that serves as a basis to present some of the lessons learned as a participant in several kinds of this type of course.

Massive refers to the unusually (if compared to traditional education) high number of enrolled students in a course. According to Jordan, “total enrolment figures range[d] from 4,500 to 226,652 students”[2].

Open may be interpreted as non-restricted access, thus leading to one of the aforementioned blurry definitions. Some MOOCs are free for the participants, i.e. there is no registration fee; therefore, the only requirement directly related to the student’s economy is having a device compatible with the platform where the course is offered, and access to the Internet. Not all courses are open in this way, as will be explained further below. Another interpretation of openness is the wide range of ages that may be found in the enrollment records. From teenagers to the elderly, MOOCs are open to anyone interested in learning. The term “life-long learning” is widely spread, and it refers to this spirit of continuous learning regardless of age and educational background.

MOOCs are offered online. MOOC providers (most often, universities) create courses often inspired in -but not equivalent to- their on campus versions. The institution provides this content using one of the MOOC platforms, e.g. Coursera (with co-founders from Stanford University) [3]. This MOOC platform was one of the most extended ones at the beginning of the MOOC “boom” and its number of MOOC providers and courses is ever growing. Thus, this is the platform where most of the examples mentioned in this paper are taken from.

Those interested in enrolling in a course may access the course information site, where the following information is usually found: short course description, workload (expected hours of work per week), course length (in number of weeks), instructor, language (of instruction and, if available, of subtitles provided for video lectures) and format of courseware (e.g. video lectures, multiple-choice quizzes, peer-reviewed essays).

Originally, MOOCs did not offered the possibility to confirm that the enrolled student was the person actually completing the assigned tasks. Instead, students agreed to the Honor Code (in the case of Coursera), which includes stating that the participant, and not anyone else, is taking part in the course with that account, and agreeing not to copy work from others. Lately, by using official identity documents and pictures taken with a web camera, the possibility of having a verified participation in the course has been offered, in exchange of a fee. Most platforms provide interested students with a certificate at the end of the course: of completion of the course (not verified) or a verified version. The validity of these certificates is a current topic of discussion: is completing this kind of course equivalent to completing a similar on campus version? Can students obtain university credits or other kind of recognition for MOOCs? How do companies consider these certificates? The discussion is ongoing, as there is no clear answer to these questions.
II. LESSONS LEARNED FROM A STUDENT’S PERSPECTIVE

The author has successfully completed more than 10 MOOCs and has tried (without completing at a 100% rate) many others across different MOOC platforms and providers. Lessons learned while having these experiences are shared here, aiming to enrich the discussion on this kind of teaching and learning.

A. Quizzes

As mentioned in the previous section, it is common in MOOCs to find multiple-choice quizzes, that are automatically corrected, as a means for students to self-assess their knowledge, or as one to assess the students’ knowledge and express it as a grade. While some courses limit the number of attempts to complete the quiz, others allow students to try as many times as desire. A good practice is to give feedback on the questions that have been erroneously answered, so that the students understand the mistake(s) and submit the quiz again, hopefully correctly this time. The experience in this kind of assessment is that limited attempts motivate to learn the content, even if the student just aims for the grade, i.e. (s)he is forced to take a closer look at the material (even if this is limited to just the questions in the test) in order to be able to get the highest score in that quiz.

B. Peer Review

Some parts of the course need to be assessed but have a format that does not accommodate to the one required for automatic assessment such as the multiple-choice question quizzes. One example would be asking students to write a short text explaining concepts or presenting opinions, e.g. an answer to the question “For which kinds of problems would you use Object Oriented Programming (OOP), and why?”. The extremely high number of students prevents the instructor and, if needed in that course, the teaching assistants (TAs) to look at all these assignments and grade them. Thus, a different system is used: each student is asked to review the work of a few of his or her fellow students.

Students doing peer review may be given instructions on how to assess or give feedback to their peers. These instructions may be delivered in the form of a rubric: listing the equivalence between a particular score and the content needed to achieve the former. Regardless of the clarity of these instructions, unfortunately it cannot be expected that all students correctly follow these guidelines. Errors (due to negligence or misunderstandings) are not unusual and may lead to frustration and even drop out by the student receiving this assessment, especially when his or her grade depends on this partial grade. While some students seem to regard peer review as a task deserving effort and time, some others spend less than the required amount of time required to give meaningful feedback. The latter case may be due, in some cases, to flaws in the student’s time management plan, a feeling that the task is too difficult or simply a lack of motivation (especially when the feedback this person has received previously has not been good). Regarding the quality of the review, it could be argued that students with more experience in this kind of course may do better at peer reviewing, which increases the quality of the experience of the participants who receive this feedback.

C. Collaboration

Students may interact in and out of the course. In the course, besides the -optional- use of peer review, forums are usually provided so that students are able to post their questions or simply participate in building the community. Sometimes these forums are monitored by TAs or students of previous instances of the course. The main instructor may do so as well but (s)he is not expected to. Some instructors are also using videoconference to interact with a selected group of students. A discussion on course-related topics or an interaction with experts in the field are examples of these sessions. Course participants may be invited to post questions and the instructor may address some of these queries during a session. The whole session may be recorded and share with the course participants afterwards. Outside the course, students are encouraged to form local groups for face-to-face study. Platforms such as MeetUp [4] facilitate these meetings.

D. Course completion and certificates

It has been mentioned that the value of the certificates offered to the students who complete a particular percentage of the course is a topic being debated. In a course with such a high number of students, is it possible to assess everything that needs to be assessed? How does this compare to the on-campus version? If the peer review process leads to a significant number of students receiving a grade lower than they deserve, how effective is this method? How does it affect motivation (and, thus, the likelihood of a student completing the course)?

However, it should not be taken for granted that all participants in a MOOC are enrolled with the goal of finishing all the tasks required for a certificate. It is a common practice to enroll just to try some modules of the course, or even to get an overall idea of the area, looking at selected parts of the material in less depth than the regular students of the MOOC. Among other reasons, those interested in trying out a field or a branch of one may use MOOCs for this purpose (a free course, as MOOCs usually are, makes experimentation much easier). If this difference in goals related to the completion of the course is not considered in the analysis of the grade statistics, these participants’ registrations may be consider as drop outs. Some of the MOOC providers are now asking students at the beginning of the course what their goals are with regards to the completion of the course in order to have more accurate statistics.
E. Learning Strategy and Flexibility

The keyword in the author’s experience in MOOCs is flexibility. MOOCs are not heavily dependent on schedule (e.g. no exams in the early morning), which allows the student to take more responsibility of his or her learning. This may lead to different results depending on the student. While some MOOCs have hard deadlines for the assignments required, other allow students to choose their own pace to complete the course. Flexibility is not only experienced by the students themselves but also by the instructors and course designers when deciding what course format to use.

Students seem to be also more free to express their opinions. Participants may post anonymously in the forums (in some platforms). But, even if they post with their names, their grade is not based on the judgement of the instructor but on other factors, as detailed above. Thus, students may feel more free to express their opinions about the course, which leads to richer feedback and, thus, more opportunities to improve the course.

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Social Networks as Effective Students-Instructor Communication and Collaboration Tool: Case Study of Computer Engineering Students

Ismat Aldmour
Department of Computer Engineering and Science
AlBaha University
AlBaha, Saudi Arabia
e-mail: iaaldmour@bu.edu.sa

Abstract— The instructor of third-year computer engineering students resorted to the use of social networks (WhatsApp group) as a supplementary method of communicating with the students outside lecture times. The group was used by the instructor to make announcements, reminders and to comment on or answer students’ questions. The group was used by the students to ask questions and to communicate with the instructor to provide feedback on difficulties and other issues. They also resorted to direct communication with the instructor to discuss their own difficulties privately. Assessment was carried out using students’ feedback through a survey questionnaire together with the instructor’s insights and notes. This method of communication was found to appeal to the students and was shown to have different positive impacts. The method proved to be a valuable communication tool that can support the traditional office meetings.

Keywords— computer engineering; social networks; effective communication;

I. INTRODUCTION

Recent years witnessed an outbreak in the use of social networks. In particular, social networks that are linked to mobile numbers (e.g. the nowadays popular WhatsApp application) and are browsed using smart phones, are gaining much more wider interest. This might be attributed to the ease of communicating with others. There is no need for logging-in passwords and user names and one can find others easily through their mobile phone numbers. The communication is instant and is provided free in many cases. Other than that, such networks allow for full multimedia sharing of text, audio, photos and video with immediate access to smart phone camera and microphone in many of them.

The instructor of third year computer engineering students, who is also the author of this paper, was facing some difficulties in communicating with his students outside lecture hours. Hence, he resorted to the use of social networks and created a group to induce an effective communication with the his students that can potentially impact their success positively. The data obtained through a survey questionnaire were analyzed and contrasted against insights from the instructor’s point of view and the different experiences during the semester.

In the rest of the paper, Section II gives a background information from literature on social networks. Section III highlights the problem more. While Section IV presents the survey conducted together with its results and analysis. Section V provides the instructor’s insights. Finally, concluding remarks and recommendations are given in the last section.

II. BACKGROUND

In an academic context, the use of the social capital can serve as an important contributor to the student academic experience [1], hence, it is crucial that educators and students become aware of the importance of social resources and their development [1]. Internet now contributes largely to students’ learning while it also becomes the basic platform for myriads of social network applications. The study in [2] conducted on 1376 engineering students enrolled in three major universities in Lebanon showed that one third of the participants spent two—five hours per week on social networking sites via the internet while 9% of the students spent more than 20 hours a week. Hence, the popularity of the electronic social networks can, if properly utilized, be used to enhance students’ academic experience.

Recently, many universities worldwide are promoting social-based education models. The work in [3] presents social design paradigm which focuses on social interaction which is called the Social Intelligence Design (SID). The main difference between Human Computer Interaction (HCI) and SID is that SID assumes a good HCI and goes beyond it [3].

Collaboration and communication is in the core of social networks. Using it, it is possible to have effective collaboration regardless of the geographic dispersion and time zone differences. For example, software developers began using forums then Wikis and now are relying more and more on micro-blogging and social networks [4]. Students are now using social network sites like Facebook as an informal tool to engage in classroom-related collaborative activities (e.g., arranging study groups and learning about course processes) [5]. Such informal collaborative groups are also being established using smart phone related social network applications such as the WhattisApp application. This paper investigated the attitudes toward and the impacts of a WhattisApp’s group that is created by the instructor and included all the students in his class in the previous academic semester.

III. THE PROBLEM AND THE SUGGESTED SOLUTION

Office hours is the traditional method of communicating with the students outside lecture hours. Instructors are obliged to announce their office hours to the students. This method was almost the only method at our times as students. Office hours are good as it provides a face to face
communication. However, it is noticeable that the students in AlBaha university, are not making good use of instructor’s office hours for obtaining academic and other help. Reasons can be attributed to many factors. Among these are that the students are not encouraged to use and/or not aware of the importance of this resource. Additionally, many instructors are heavily loaded with additional administrative work loads with that office hours are the least respected whenever time overlap occurs. Moreover, many instructors are being exchanged between colleges, which can be in different buildings and in different areas of the city as well. AlBaha university was established in 2006 and it started using rented buildings around the city but now we have the main campus though not all buildings are ready yet. This renders office hours almost useless in such cases. This issue can be more serious for the female sections as a large percentage of courses are taught to them by male instructors through closed circuit TV (CCTV) systems. In this system, a male instructor lectures from a CCTV equipped studio that is separate from the classroom itself. In such a situation, girls have no provision at all to make use of the office hours. In the college of computer science and information technology, where this study was conducted, all computer science classes are taught by male instructors through CCTVs due to the unavailability of female instructors at present.

Currently, technology is somehow replacing or supporting office hours. Learning Management Systems (LMS) provide platforms for uploading supplementary material and announcements. Additionally, they enable discussion groups and email communication with the students. Such technologies can be of a great help to provide the kind of support that can overcome many of the problems accompanying office hours. Unfortunately, there is, so far, a reluctance to adopting and promoting a proper LMS platform and the currently adopted tool suffers from many weaknesses that renders it less useful or probably useless in providing the required support.

As a result, many instructors in the university rely on some replacement tools that cannot provide the required support. One common method is to rely on the class coordinating student. The role of the coordinating student is to ensure that lecture notes and other resources provided by the instructor are copied and distributed to all the students in the class. He may also help in conveying announcements by the instructor to the rest of the students. Needless to say that the coordinating student method is very primitive and with lots of shortcomings and disadvantages.

This situation calls for innovation in methods of communication with the students, mainly using available free tools of the internet. The author himself resorted to some of these tools, e.g. Google Drive, Google Groups, Dropbox and email groups. These helped making available the lecture notes and other resources, e.g. video recorded lectures that the author tried the last semester (discussed in other paper by the author in this symposium [6]). Relying on these tools can be somehow successful as in the case of the author himself. Nevertheless, there can be difficulties such as getting acquainted to the tool by the students and the instructor himself. Having a unified tool supported by the university will help get rid of such difficulties.

The author, was the instructor during the last semester (2014/2015) of two courses; electric circuits II and Microelectronics Circuits I which are taught to the same group of 14 male students in the Computer Engineering department. In his case, he noticed the reluctance of the students to make use of the announced office hours. He was also heavily loaded with administrative work loads with not much help of the LMS tool adopted by the university. At the same time, he also noticed the spread of smart phones among the students and the heavy use of the social networks by the students. Hence, he realized that an organized use of such social networks can be a helpful supplementary tool. Hence, in addition to the resort to some of the above free internet tools for uploading lectures and other resources, he created a group using the social “WhatApp” application (named it Circuits & Circuits group after the title of the two courses taught to the same group of students). The main purpose of the group was to create an effective communication with the students. The instructor used this group to make announcements to the students, e.g. that a recorded new lecture has been uploaded, an exam reminder, some clarifications of important points, answers to students’ questions sent by any of the students using the same group and even a reminder to bring the calculator to tomorrow’s exam. The instructor also used the tool for other guidance and psychological purposes, e.g. to answer to a student’s anxieties and worries trying to relief him and to wish the students success in tomorrow’s exam. The students used the tool mainly to ask for clarifications on the problems they face while reviewing (mainly while solving home works or preparing to exams). Both the instructor and the students used video and audio beside text in question making and question answering.

IV. THE QUESTIONNAIRE AND RESULTS

A questionnaire of 10 terms using 5-level Likert scale was designed and conducted on all of the students in the two courses (same students in both courses). The questionnaire terms and its results are presented in Table 1. The questionnaire objectives were to assess the students’ attitude toward this method of communication and to assess the potential impacts this method might had on them. In the following objectives are presented together with the related terms in the questionnaire. The results are also presented and discussed.

- The first objective was to assess the attitude of the students toward this method of communication. Terms 1, 2, 4, 7, 8, and 9 in the table try to answer this. From the results and the calculated averages, which ranged from strongly agree to agree, it can be easily seen that the students developed positive attitudes toward this method of communication. They strongly believed that this method was useful in communicating with the instructor, enhanced their feelings of being connected with the instructor and other peers, and the instructor’s responses reflected positively on them. They expressed their preference of this method than the indirect method through the coordinating student. They
also wished that the instructor continue, and that other instructors start using this method of communication in upcoming courses.

- Secondly, to assess the impacts this method might had on them. Terms 3, 5, 6 and 10 try to answer this. They strongly assured that the discussions, questions and answers by the instructor were beneficial to them academically and impacted their grades positively. Also, they strongly agreed that the group kept them abreast of the instructor’s instructions and guidance and contributed to less anxieties during exam times.

## Table 1: The questionnaire and its results.

<table>
<thead>
<tr>
<th>#</th>
<th>Question</th>
<th>Str. Agree</th>
<th>Agree</th>
<th>Neutral</th>
<th>Disagree</th>
<th>Str. Disagree</th>
<th>Avg.</th>
<th>Scale</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>I believe that having a “WhattsApp” group for each course is useful in communicating with the instructors.</td>
<td>10 3 1 0 0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4.64</td>
<td>SA</td>
</tr>
<tr>
<td>2</td>
<td>The group enhanced my feelings that I am more connected with the instructor and my peers.</td>
<td>10 4 0 0 0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4.71</td>
<td>SA</td>
</tr>
<tr>
<td>3</td>
<td>I benefited from the discussions, questions and answers by the instructor</td>
<td>11 3 0 0 0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4.78</td>
<td>SA</td>
</tr>
<tr>
<td>4</td>
<td>The instructor’s responses reflected positively on me</td>
<td>13 0 1 0 0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4.86</td>
<td>SA</td>
</tr>
<tr>
<td>5</td>
<td>The group kept me abreast of the instructor’s instructions and</td>
<td>11 0 2 1 0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4.50</td>
<td>SA</td>
</tr>
<tr>
<td>6</td>
<td>The group contributed to less pressure during exam times</td>
<td>8 4 1 1 0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4.36</td>
<td>SA</td>
</tr>
<tr>
<td>7</td>
<td>I prefer the electronic group method to communicate with the instructor than the indirect method through a coordinating student</td>
<td>7 3 3 0 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4.07</td>
<td>A</td>
</tr>
<tr>
<td>8</td>
<td>I wish that the instructor continue using the group method in upcoming courses with him.</td>
<td>9 4 1 0 0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4.57</td>
<td>SA</td>
</tr>
<tr>
<td>9</td>
<td>I wish that all other instructors resort to creating groups for their courses as well.</td>
<td>7 3 4 0 0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4.21</td>
<td>SA</td>
</tr>
<tr>
<td>10</td>
<td>I believe that the group impacted my grades positively.</td>
<td>6 7 1 0 0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4.36</td>
<td>SA</td>
</tr>
</tbody>
</table>

V. INSTRUCTOR’S INSIGHTS

The positive results of the questionnaire in the previous section will be discussed here in light of the instructor’s notes and experiences during this experiment.

Due to the ineffective learning management tool of the university and other difficulties presented above, the instructor had to rely partly, in previous semesters, on the coordinating student in some tasks and announcements. This is though that he is not in favor of this method. After all, the communication with the students is indirect which justifies the positive attitude toward the group method in which each student has the same provision to communicate with the instructor. Hence feeling connected with positive impacts.
I believe that one more reason for the less frequent use of instructor’s office hours by the students is that the students mainly need the instructor’s assistance at times where the office is closed, e.g., in the evenings and over the weekends and off days before exams or homework assignments. The course group enables access to instructor’s assistance at such times. Of course, it can be argued that this gives hard time to the instructor in his off times. In my case, I encouraged them to contact me at these times, but not too late in the night. I was fortunate to have two small classes of 14 students each (same students) which probably made this bearable. Additionally, I was happy to proceed with this experiment and answer the students’ questions almost at any time. However, if such a model is to be generalized to all instructors, it might be that instructors will be required to commit to less office hours as a replacement. Also, I found that in many cases, the students have common difficulties and answering to one student’s question is enough to avoid duplicate or similar other requests for help. Figure 1 shows a video recording snapshot of a request for assistance made by one student while reviewing in a group (Figure 2).

Figure 1: A snapshot of a student's video/audio request for academic assistance.

I also believe that the students’ felt less pressurized during exam times as they probably got the feeling that the role of the instructor extended to assist them in preparing for the exams and he is also “suffering” like them!. Figure 2 sent by one of the students shows the excitement about sharing the status and feelings with the instructor and the rest of the group over an exam night.

VI. CONCLUSION

Office hours and learning management tools are the typical methods to offer academic and other assistance to the students outside lecture hours. However, there are, currently, some difficulties and problems related to office hours and learning management tools in AlBaha university. In this experiment, the instructor resorted to social networks on the mobile to effect communication with the students as a supplementary method.

It is found that this method was received positively by the students and enhanced the communication between the instructor and the students. It also contributed to reduced feelings of anxieties and pressure during the exam times. Moreover, it contributed to improved academic levels as assured by the students themselves.

In summary the method proved to help in providing the required assistance to the students that is typically the role of office hours and learning management tools.

REFERENCES


Figure 2: Students study in a group.


**e-Learning and Ethical Development – impact on the students learning experience**

Farooq Ahmad  
College of Computer Science & Information Technology, University of AlBaha,  
Al Baha, Kingdom of Saudi Arabia  
drfarooqa@gmail.com

AbdulHafeez Muhammad  
1 College of Computer Science,  
King Khalid University, Kingdom of Saudi Arabia  
2 Department of IS, Kulliya of ICT,  
International Islamic University, Malaysia.

Abstract— a study is performed to investigate the state of ethical development in e-Learning environments. Efforts are made to identify the main factors required for the ethical development of student and to investigate their need in e-Learning environments. The work also surveyed the state of e-Learners on various ethical behaviors. The study emphasized that the physical presence of teacher, an ethically conducive institutional environment and the involvement of the society members (family friends and society in general) are among the main factors helping in the ethical development of a student. The results of the study showed that the moral behavior of e-Learners is at decline and the factors important for the ethical development of e-Learners are missing. The work continues to provide suggestions on how to improve the ethical development of e-Learners.

I. INTRODUCTION

The objectives of professional and technical education are to produce graduates who have technical competence with usefulness to the society. The written codes of ethics and making it binding on the members to follow, for almost all the professional bodies (IEEE, ACM, Medical and others), is an indication of the necessity of ethical understanding [1]. Many studies show that ethical understanding and its application are declining in the graduates [2]–[5] which is creating harmful situations for the society. There are many reasons for the gradual decline in the ethical development of graduates [5]–[8]. Some of them identified as attention to child at the early age in the family [9]–[11], disintegrating family systems [2], [11], no attention to ethical development in the early education [7], [12], the philosophy that knowledge should be independent of the religion and local social context [13]–[15], disappearance of explicit contents on ethics from the course material [2], [16], and the quick fix approach & economic push to teach market oriented courses [2], [17]. The study is conducted as a part of larger project to assess the ethical behavior of e-learners and see if the e-learners are behaving negatively, then to identify what could be the reasons for this vulnerability.

II. E-LEARNING AND ETHICAL DEVELOPMENTS

King Khalid University, Abha, is one of the largest universities in KSA having more than 70 thousand students and offering blended and online courses along with the traditional offerings in various disciplines [18]. Many researchers have pointed out that although the ethical development of graduates and professionals in general is at decline, the situation is more alarming in case of e-Learning [3], [5], [6], [16], [19]–[22]. A similar perception that the ethical behavior of students in online courses is weaker as compared to the courses offered through traditional methods existed in King Khalid University. To demystify the situation this study was initiated. The objective is to study the state of ethical behavior of e-Learners, identify the main factors of ethical development, and identify the factors responsible for the lesser ethical behavior of e-learners.

III. RESEARCH METHODOLOGY AND DATA COLLECTED

A. Basic features taken from the literature

The first approach adopted from the literature is that society builds the character of individuals and society bears the fruits of ethical and unethical behavior of its individuals. Kenan is of the opinion that any profession in the world cannot ignore the importance of character development of an individual [23]. Similarly Ozturk believes that each professional category is responsible for working towards the development of the society [24]. Lind concludes that whole society may become demoralized if the professionals become immoral [25]. Therefore, the first factor looked into is the role of society in the ethical development of students. In this category the role of family, friends, and the members of society in general are looked into.

The Biggs Learning Model [26] is used in higher education literature to explain the fundamental elements that exist in students learning. According to Biggs, student learning involves three stages – input, process and output –which are closely interconnected. In this respect character development and its relevance is looked into all the three stages of the model i.e.

- **Input** - teacher, course contents, and the environment,
- **Process** - the Learning Management Systems (LMS), Pedagogies, and the policies and rules of the institutions, and
- **Output** - the graduate (e-Learner), his/her impact on the society and vice versa.

Narvaez Integrative Ethical Education (IEE) [27] model is used for the wholeness of the personality and performance of e-Learners. The IEE is considered in our
work to look into all aspects of students' development including course contents, teacher interaction, institution policies and role of the society.

According to Kohlberg [28] individuals develop their moral reasoning and their ethical behavior in at least six stages. The third level of his model is relevant to our work in three ways, firstly that ethical development is relevant to the society, secondly there do exist (may be in various forms) universal ethical principles and thirdly that at the autonomous or principle level (tertiary education/mature age) they have to be developed.

B. Instrument and Data Collection

Based on the literature discussed above a questionnaire was developed for three areas to explore. Firstly to explore the comparative behavior of e-Learner, secondly to see the important factors required for the character development of students and thirdly to observe the status of these important factors in e-Learning environments.

The data was collected from 376 students, teachers and administrative staff of King Khalid University all involved in e-Learning. It is important to note that all the respondents had experience with both the traditional course offerings and the e-Learning courses. The respondents belonged to various disciplines and had varying experience with e-Learning as shown in table-1 and table-2 respectively.

<table>
<thead>
<tr>
<th>Respondents</th>
<th>IT &amp; Engineering</th>
<th>Science</th>
<th>Management Studies</th>
<th>Sharia &amp; Law</th>
<th>Medical</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teachers</td>
<td>21</td>
<td>10</td>
<td>4</td>
<td>7</td>
<td>5</td>
<td>47</td>
</tr>
<tr>
<td>e-Learning Staff</td>
<td>14</td>
<td>6</td>
<td>6</td>
<td>2</td>
<td>3</td>
<td>31</td>
</tr>
<tr>
<td>Students</td>
<td>121</td>
<td>59</td>
<td>57</td>
<td>53</td>
<td>8</td>
<td>298</td>
</tr>
<tr>
<td>Total</td>
<td>156</td>
<td>75</td>
<td>67</td>
<td>62</td>
<td>16</td>
<td>376</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Respondents</th>
<th>Less than 1 year</th>
<th>More than 1 year but less than 3 years</th>
<th>More than 3 years</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teachers</td>
<td>11</td>
<td>23</td>
<td>13</td>
<td>47</td>
</tr>
<tr>
<td>e-Learning Staff</td>
<td>8</td>
<td>3</td>
<td>20</td>
<td>31</td>
</tr>
<tr>
<td>Students</td>
<td>80</td>
<td>115</td>
<td>103</td>
<td>298</td>
</tr>
<tr>
<td>Total</td>
<td>99</td>
<td>141</td>
<td>136</td>
<td>376</td>
</tr>
</tbody>
</table>

IV. STATE OF ETHICAL BEHAVIOR OF E-LEARNERS

To observe the ethical status of e-Learners only three values i.e., plagiarism, punctuality (attendance/attention) and miscommunication (false representation/telling lies) are taken. Many researchers [29], [30] have taken these as the general indicators of unethical behavior of e-Learners. The participants were asked to compare the status of the students' behavior for these values as in their conduct in online courses as compared to the normal courses.

A. Plagiarism

Statement asked: In online assignments and quizzes through LMS, plagiarism, copy/paste and cheating are common among students.

Details of responses can be seen in table-3 with an overall average response of 4.37 (with the scale 0-5).

<table>
<thead>
<tr>
<th>level</th>
<th>Frequency</th>
<th>Percent</th>
<th>Cumulative Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strongly Disagree</td>
<td>2</td>
<td>.5</td>
<td>.5</td>
</tr>
<tr>
<td>Disagree</td>
<td>5</td>
<td>1.3</td>
<td>1.9</td>
</tr>
<tr>
<td>Neutral</td>
<td>22</td>
<td>5.9</td>
<td>7.7</td>
</tr>
<tr>
<td>Agree</td>
<td>170</td>
<td>45.2</td>
<td>52.9</td>
</tr>
<tr>
<td>Strongly Agree</td>
<td>177</td>
<td>47.1</td>
<td>100.0</td>
</tr>
</tbody>
</table>

B. Low Attendance and Attention

Statement asked: In online classes through LMS, actual attendance is low and the students are not attentive.

Details of responses can be observed in table-4 with an overall average response of 3.72.

<table>
<thead>
<tr>
<th>level</th>
<th>Frequency</th>
<th>Percent</th>
<th>Cumulative Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strongly Disagree</td>
<td>17</td>
<td>4.5</td>
<td>4.5</td>
</tr>
<tr>
<td>Disagree</td>
<td>24</td>
<td>6.4</td>
<td>10.9</td>
</tr>
<tr>
<td>Neutral</td>
<td>106</td>
<td>28.2</td>
<td>39.1</td>
</tr>
<tr>
<td>Agree</td>
<td>131</td>
<td>34.8</td>
<td>73.9</td>
</tr>
<tr>
<td>Strongly Agree</td>
<td>98</td>
<td>26.1</td>
<td>100.0</td>
</tr>
</tbody>
</table>

C. Miscommunication

Statement asked: In online courses through LMS, while communicating with the teachers and other students, students tell lie (e.g. about accessing the internet and have read material from the internet etc.). Details of responses can be seen in table-5 with average response of 3.63.

<table>
<thead>
<tr>
<th>level</th>
<th>Frequency</th>
<th>Percent</th>
<th>Cumulative Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strongly Disagree</td>
<td>22</td>
<td>5.9</td>
<td>5.9</td>
</tr>
<tr>
<td>Disagree</td>
<td>44</td>
<td>11.7</td>
<td>17.6</td>
</tr>
<tr>
<td>Neutral</td>
<td>77</td>
<td>20.5</td>
<td>38.0</td>
</tr>
<tr>
<td>Agree</td>
<td>141</td>
<td>37.5</td>
<td>75.5</td>
</tr>
<tr>
<td>Strongly Agree</td>
<td>92</td>
<td>24.5</td>
<td>100.0</td>
</tr>
</tbody>
</table>

V. FACTORS IDENTIFIED AS ESSENTIAL FOR ETHICAL DEVELOPMENT

The literature indicated that the main factors for ethical development are the teacher, members of society (including parents, family & friends) and explicit course contents on ethics.

A. Role of Teacher

Statement asked: Physical presence of teacher plays a major role in the character development of the students in academic institutions. Details of responses can be seen in table-6 with an average response of 4.29.
B. Role of Society
Statement asked: Members of society (family, parents, friends, colleagues etc.) play a major role in the character development of students. Details can be seen in table-7 with an average response of 4.15.

<table>
<thead>
<tr>
<th>Role of Society Member</th>
<th>Frequency</th>
<th>Percent</th>
<th>Cumulative Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strongly Disagree</td>
<td>10</td>
<td>2.7</td>
<td>2.7</td>
</tr>
<tr>
<td>Disagree</td>
<td>17</td>
<td>4.5</td>
<td>5.1</td>
</tr>
<tr>
<td>Neutral</td>
<td>48</td>
<td>12.8</td>
<td>17.8</td>
</tr>
<tr>
<td>Agree</td>
<td>170</td>
<td>45.2</td>
<td>63.0</td>
</tr>
<tr>
<td>Strongly Agree</td>
<td>153</td>
<td>40.7</td>
<td>100.0</td>
</tr>
</tbody>
</table>

C. Role of Academic Institutions
Statement asked: Physical environment (class room, home, company of friends, location i.e., internet-café or other places) plays a major role in the character development of students. Details of responses can be seen in table-8 with an average response of 4.14.

<table>
<thead>
<tr>
<th>Role of Academic Institution</th>
<th>Frequency</th>
<th>Percent</th>
<th>Cumulative Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strongly Disagree</td>
<td>2</td>
<td>5</td>
<td>5.0</td>
</tr>
<tr>
<td>Disagree</td>
<td>17</td>
<td>4.5</td>
<td>5.1</td>
</tr>
<tr>
<td>Neutral</td>
<td>48</td>
<td>12.8</td>
<td>17.8</td>
</tr>
<tr>
<td>Agree</td>
<td>170</td>
<td>45.2</td>
<td>63.0</td>
</tr>
<tr>
<td>Strongly Agree</td>
<td>153</td>
<td>40.7</td>
<td>100.0</td>
</tr>
</tbody>
</table>

D. Role of Explicit Contents on Ethics in the Courses
Statement asked: Ethical contents in curriculum play a major role in character development of students. Details of responses can be observed in table-9 with an average response of 3.53.

<table>
<thead>
<tr>
<th>Role of Ethical Contents</th>
<th>Frequency</th>
<th>Percent</th>
<th>Cumulative Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strongly Disagree</td>
<td>19</td>
<td>5.1</td>
<td>5.1</td>
</tr>
<tr>
<td>Disagree</td>
<td>36</td>
<td>9.6</td>
<td>14.6</td>
</tr>
<tr>
<td>Neutral</td>
<td>122</td>
<td>32.4</td>
<td>47.1</td>
</tr>
<tr>
<td>Agree</td>
<td>142</td>
<td>33.0</td>
<td>80.1</td>
</tr>
<tr>
<td>Strongly Agree</td>
<td>75</td>
<td>19.9</td>
<td>100.0</td>
</tr>
</tbody>
</table>

VI. STATUS OF FACTORS ESSENTIAL FOR ETHICAL DEVELOPMENT OF E-LEARNER
Here an effort is made to observe the status of factors, essential for ethical development in e-Learning environments. The status of factors enquired about is the role of teacher, society, institution and contents

A. Status of Role of Teacher
Statement asked: There is a lack of face-to-face interaction among the students and teachers in online studies which affect the character of students negatively. Details of responses are given in table-10 with an overall average response of 4.03 (on a scale of 0-5).

B. Status of Institution and Policy
Statement asked: Independent and flexible learning environment (online classes, home, company of friends, location i.e., internet-café or other places) provided for e-Learning are not appropriate for the character development of students and affecting negatively. Details can be seen in table-11 with average response of 3.95.

C. Status of Society Involvement
Statement asked: There is lack of involvement of members of the society (parents and guardian of students), to know about the progress of a student and their activities in LMS, which is affecting character development of a student negatively. Details can be observed in table-12 with average response of 4.14.

D. Status of Explicit Contents on Ethics in Courses
Statement asked: There is lack of ethical contents in curriculum for online courses through LMS which is negatively affecting the character of students. Details can be seen in table-13 with average response of 3.94.

---

**TABLE 6. ROLE OF TEACHER**

<table>
<thead>
<tr>
<th>Level</th>
<th>Frequency</th>
<th>Percent</th>
<th>Cumulative Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strongly Disagree</td>
<td>1</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Disagree</td>
<td>8</td>
<td>2.1</td>
<td>2.4</td>
</tr>
<tr>
<td>Neutral</td>
<td>32</td>
<td>8.5</td>
<td>10.9</td>
</tr>
<tr>
<td>Agree</td>
<td>176</td>
<td>46.8</td>
<td>57.7</td>
</tr>
<tr>
<td>Strongly Agree</td>
<td>159</td>
<td>42.3</td>
<td>100.0</td>
</tr>
</tbody>
</table>

**TABLE 7. ROLE OF SOCIETY MEMBER**

<table>
<thead>
<tr>
<th>Role of Society Member</th>
<th>Frequency</th>
<th>Percent</th>
<th>Cumulative Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strongly Disagree</td>
<td>10</td>
<td>2.7</td>
<td>2.7</td>
</tr>
<tr>
<td>Disagree</td>
<td>17</td>
<td>4.5</td>
<td>5.1</td>
</tr>
<tr>
<td>Neutral</td>
<td>48</td>
<td>12.8</td>
<td>17.8</td>
</tr>
<tr>
<td>Agree</td>
<td>170</td>
<td>45.2</td>
<td>63.0</td>
</tr>
<tr>
<td>Strongly Agree</td>
<td>153</td>
<td>40.7</td>
<td>100.0</td>
</tr>
</tbody>
</table>

**TABLE 8. ROLE OF ACADEMIC INSTITUTIONS**

<table>
<thead>
<tr>
<th>Role of Academic Institution</th>
<th>Frequency</th>
<th>Percent</th>
<th>Cumulative Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strongly Disagree</td>
<td>2</td>
<td>5</td>
<td>5.0</td>
</tr>
<tr>
<td>Disagree</td>
<td>17</td>
<td>4.5</td>
<td>5.1</td>
</tr>
<tr>
<td>Neutral</td>
<td>48</td>
<td>12.8</td>
<td>17.8</td>
</tr>
<tr>
<td>Agree</td>
<td>170</td>
<td>45.2</td>
<td>63.0</td>
</tr>
<tr>
<td>Strongly Agree</td>
<td>153</td>
<td>40.7</td>
<td>100.0</td>
</tr>
</tbody>
</table>

**TABLE 9. ROLE OF ETHICAL CONTENTS**

<table>
<thead>
<tr>
<th>Role of Ethical Contents</th>
<th>Frequency</th>
<th>Percent</th>
<th>Cumulative Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strongly Disagree</td>
<td>19</td>
<td>5.1</td>
<td>5.1</td>
</tr>
<tr>
<td>Disagree</td>
<td>36</td>
<td>9.6</td>
<td>14.6</td>
</tr>
<tr>
<td>Neutral</td>
<td>122</td>
<td>32.4</td>
<td>47.1</td>
</tr>
<tr>
<td>Agree</td>
<td>142</td>
<td>33.0</td>
<td>80.1</td>
</tr>
<tr>
<td>Strongly Agree</td>
<td>75</td>
<td>19.9</td>
<td>100.0</td>
</tr>
</tbody>
</table>

**TABLE 10. STATUS OF TEACHER IN E-LEARNING**

<table>
<thead>
<tr>
<th>Level</th>
<th>Frequency</th>
<th>Percent</th>
<th>Cumulative Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strongly Disagree</td>
<td>4</td>
<td>1.1</td>
<td>1.1</td>
</tr>
<tr>
<td>Disagree</td>
<td>8</td>
<td>2.1</td>
<td>3.2</td>
</tr>
<tr>
<td>Neutral</td>
<td>86</td>
<td>22.9</td>
<td>26.1</td>
</tr>
<tr>
<td>Agree</td>
<td>154</td>
<td>41.0</td>
<td>67.0</td>
</tr>
<tr>
<td>Strongly Agree</td>
<td>124</td>
<td>33.0</td>
<td>100.0</td>
</tr>
</tbody>
</table>

**TABLE 11. STATUS OF INSTITUTION AND POLICY**

<table>
<thead>
<tr>
<th>Level</th>
<th>Frequency</th>
<th>Percent</th>
<th>Cumulative Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strongly Disagree</td>
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<td>7.2</td>
<td>7.2</td>
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<tr>
<td>Disagree</td>
<td>16</td>
<td>4.3</td>
<td>11.4</td>
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<td>27.7</td>
</tr>
<tr>
<td>Agree</td>
<td>117</td>
<td>31.1</td>
<td>58.8</td>
</tr>
<tr>
<td>Strongly Agree</td>
<td>155</td>
<td>41.2</td>
<td>100.0</td>
</tr>
</tbody>
</table>

**TABLE 12. STATUS OF SOCIETY INVOLVEMENT**

<table>
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<tr>
<th>Level</th>
<th>Frequency</th>
<th>Percent</th>
<th>Cumulative Percent</th>
</tr>
</thead>
<tbody>
<tr>
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<td>4</td>
<td>1.1</td>
<td>1.1</td>
</tr>
<tr>
<td>Disagree</td>
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<td>1.6</td>
<td>2.7</td>
</tr>
<tr>
<td>Neutral</td>
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<td>17.0</td>
</tr>
<tr>
<td>Agree</td>
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<td>48.1</td>
<td>65.2</td>
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<tr>
<td>Strongly Agree</td>
<td>131</td>
<td>34.8</td>
<td>100.0</td>
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</tbody>
</table>

**TABLE 13. STATUS OF EXPPLICIT CONTENTS ON ETHICS IN COURSES**

<table>
<thead>
<tr>
<th>Level</th>
<th>Frequency</th>
<th>Percent</th>
<th>Cumulative Percent</th>
</tr>
</thead>
<tbody>
<tr>
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<td>5.3</td>
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<tr>
<td>Disagree</td>
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<td>45.5</td>
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</tr>
<tr>
<td>Strongly Agree</td>
<td>122</td>
<td>32.4</td>
<td>100.0</td>
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</table>
VII. CONCLUSION AND FUTURE WORK

The study was performed to investigate the status of ethical behavior of students in an e-Learning environment as compared to the traditional teaching environments. The study also aimed to identify the main factors essential for the ethical development of the students and then to see the status of these essential factors in an e-Learning environment.

Three hundred and seventy six (376) stack holders of an e-Learning environment i.e., students, teachers and administrative were surveyed through a questionnaire developed from various models presented in the literature. Students’ comparative behavior was tested on three values of plagiarism, attendance/attention, and miscommunications/lies. With an average of 4.37, 3.72 and 3.62 respectively for each value (out of 5 lector scale) all the respondents agreed that the behavior of e-Learners is less unethical as compared to observed in traditional courses.

Teacher, society members (family and friends etc.), environment and policies of academic institution, and teaching of explicit content on ethics were identified as essential factors for the ethical development of students. The agreement of the respondents to these factors as being essential was with an average of 4.29, 4.15, 4.14 and 3.53 respectively for each factor.

When respondents were enquired about the status of these essential factors in e-Learning environments they agreed that lack of physical presence of teacher, no involvement of society members (family and friends etc.), no ethically conducive environment and policies of academic institution, and absence of explicit contents on ethics in courses is the cause of ethical decline of the e-Learner. Statistically the agreement was with an average response of 4.03, 3.95, 4.14 and 3.94 respectively for each factor.

The work done is part of a bigger project which still continues. Work is in progress to find ways and models which can compensate for the deficiencies identified in the ethical development of e-Learners.

REFERENCES

Envisioning the Education of the Future

Arnold Pears
Department of Information Technology
Uppsala University
Box 325, 751 05 Uppsala, SWEDEN
Ph: +46 18 4711066, FAX: +46 18 55 02 25
Firstname.Lastname@it.uu.se

Abstract—The digital information revolution has enormous implications for education. University education, with its historical reliance on spatial and temporal co-location of learners and focus on transmission of information through lectures, becomes increasingly irrelevant in the emerging high-tech information society of the future. In this paper we explore avenues towards a radical paradigm shift in higher education. The basic premises are ubiquitous access to information, the integration of virtual and physical networking and the emergence of augmented spaces which draw on emerging technologies, such as google glass, to overlay virtual representations with the physical world, augmenting our perception and experience through a powerful melding of virtual and physical resources and stimuli.

Drawing on our technological and pedagogical research we propose a new epistemology of education in which the knowledge ecology of each individual can be nurtured and supported as it develops. We integrate results from e-learning, socio-constructivist learning theory and cognitive change theory to propose a new interactive learner-centric paradigm for the education of the future.

Motivation

A crucial element of current higher education strategy is to increase stakeholder collaboration and engagement in shaping the future of Engineering Education in Europe and abroad. From the research and development perspective the goal is to develop integrated and continuous improvement models which will increase the agility and pace of educational evolution. Anticipated outcomes include, increased competitiveness and relevance of education, improved stakeholder relevance of education, and facilitating rapid incorporation of stakeholder input into future learning approaches.

Expanding the scope and accessability of knowledge through technology and new pedagogies enables us to enrich our higher education process providing educational pathways which appeal to a broader and more diverse student population. Perceptions of technical and engineering identity are also vital, since we believe they will be essential to understanding how to reach a broader learner base as we move towards creating the engineering education of the future.

Trends in Higher Education

The focus and mission of higher education has experienced several dramatic political and strategic shifts over the last three decades. The university mission of, research and education of an intellectual elite in the service of society, has been replaced to a very large extent by a pragmatic and utilitarian view [1]. The purpose of higher education in Europe is currently largely seen as providing the corporate, government and industry employment sector with highly qualified workers. A discussion of the types of possible future that can be envisaged for higher education can be found in Barnett [2].

In conjunction with this change in the focus of policy makers, and the resulting pressure on higher education to produce graduates to meet the needs of employers, significant focus has been placed on graduate outcomes, and aligning assessment, learning outcomes, and curriculum in an environment where a large proportion of the population is expected to engage with higher education institutions.

In higher education research much work has been published during this process analysing and describing new challenges and outlining and evaluating strategies for successfully expanding the scope and effectiveness of the higher education endeavour. John Biggs has been highly influential through his work on "constructive alignment", and the role of the teacher in facilitating learning and assessing appropriate student outcomes [3], [4]. The research of Graham Gibbs and colleagues over the past three decades has resulted in compilations of accepted best practices in teaching and learning in higher education, much of which results from the change in the overall mission of higher education [5].

Recent developments in the technology have stimulated speculation on the future of higher education and the traditional university. Ernst and Young [6] predicted the demise of traditional higher education in Australia in a report published in 2009, and the emergence of the Massive Open Online Course (MOOC) movement has generated considerable speculation and uncertainty. Virtual environments are becoming increasingly powerful and, for instance, the role that platforms such as "Second Life" can play in education has been explored extensively [7].

Characteristics of the Education of the Future

Crafting a new educational paradigm that supports continuous learning, and increases the relevance of education in shaping European economic success in the coming decades
necessarily involves developing and evaluating education aspects, such as, pedagogies, technologies, and methods for assessment.

A major objective of this discussion in this paper is to try to propose educational approaches which connect future educational content, practices, pedagogies, models and technologies to key stakeholder groups, including policy-makers, entrepreneurs, industry, educational institutions and the general public.

This challenge emerges from a vision of accessible and broad reaching engagement between the higher education sector and pre and post-university learners. To achieve this vision we propose that future education should be based on the following general principles and values, a flexible and adaptive education offered in the Third Cycle should:

- be non-linear and individualized, but coherent at the systemic level,
- integrate disciplines, technologies and life experience,
- be offered in flexible ways,
- be highly efficient and optimize use of resources,
- provide support for continuous and lifelong learning,
- engage with both pre- and post-university learners.

These characteristics imply that our understanding of education as separated from other aspects of personal and working life is insufficient. Emergence of new technologies over the past decades has changed the ways in which we access information, and in which knowledge is acquired by new generations of learners. Knowledge and information are available in multiple forms through the Internet, as video, text. Learning no longer needs to be geographically delimited to the campus environment of Universities, and virtual educational opportunities are offered increasingly frequently.

TECHNOLOGICAL AND PEDAGOGICAL IMPLICATIONS

The traditional model of the university as a place where knowledge was collected, and mediated to new generations of scholars was predicated upon methods for assembling, and curating knowledge. Libraries of books, and the communities of scholars who had acquired insights through access the collected wisdom encoded in large collections of manuscripts and historical writings lie at the core of university culture. In the not so distant past access to large collections of scholarly literature and a climate of scholarly debate was highly geographically limited.

For hundreds of years universities built their reputations upon the strength of their libraries and the reputations of their scholars. Well known scholars such as Rudbeck and Linneus in Uppsala for instance gathered substantial followings and were widely renowned [8]. Since antiquity the scarcity of written texts conferred a special status on the practice of giving public lectures. The transmission of knowledge through note-taking and scholarly discourse was central to establishing and maintaining academic standards.

These practices and priorities persisted into the twentieth century as the cost of maintaining the large libraries needed to support high level scholarship remained high. The radical paradigm shift in information curation and access precipitated by widespread access to the Internet, combined with widespread investment in digitisation of libraries, has changed the landscape of higher education radically. Transmission of information is no longer central to the university mission. Lecturing is largely being supplanted by other modes of access to information.

Instruction delivered through video-recordings made available through services like YouTube has emerged as a major source of knowledge for younger learners. Massive Open Online Courses (MOOC) have also emerged as a force for change, placing pressure on universities to recognise knowledge acquired in other ways than through campus based instruction.

Pervasive technologies also open up new opportunities for learning. Virtual environments combine interactive immersive learning for geographically dispersed student groups with new ways to present information and scaffold learning. The pedagogical implications are considerable. The traditional educational environment has been studied by many researchers [9], [10], [11] and is fairly well understood from both the teacher and student perspective. Education in virtual environments has been found to be considerably harder to do successfully than was initially supposed. MOOC efforts have shown limited success, characterised by low student participation and completion rates. Clearly a new pedagogy is needed in order to realise the potential of the information age and the new approach to immersive online learning.

In addition to the pedagogical challenges there are significant challenges in terms of certification of learning outcomes presented by these new approaches to learning. Student learning outcomes will need to be tracked and verified in new ways. The association of knowledge and competence with an individual is problematic in virtualised and online environments. How will learners authenticate themselves, and document their acquisition of knowledge and skills? How will universities assess student achievement and recognise achievement through registering learning credits, and how will these learning credits lead to awarding of higher education degrees?

To meet these challenges we propose that the education of the future should draw upon the socio-constructivist theory of learning [12], in which knowledge and proficiency can be viewed as a process by which each learner constructs personal knowledge structures and mental models, related to the topics and concepts studied, in response to personal experience and stimuli. These learning stimuli are experienced by each individual learner not only on a personal basis, but also through negotiation on meaning in the social context of the learning environment, and in interaction with other learners and content knowledge experts.

This implies that educational environments should focus on providing each learner with experiences that build on existing proficiencies and knowledge, and challenge preconceptions in order to facilitate the construction of more sophisticated mental models of the phenomena and concepts being studied [13].
In this process conceptual change theory provides an important inspiration, helping educators to understand how to provide appropriate experiences which can catalyse learning and the necessary shifts in conceptual ecology required to achieve individual learning outcomes.

CONCLUSIONS

The landscape of higher education will change radically over the coming decade. Traditional campus based education will be enhanced by a range of virtual educational approaches, which draw on Internet and pervasive computing technologies to deliver information and support learning in new ways. Attending the university of the future will be a highly individual experience, centered on the learner. This poses new challenges for universities, in terms of assessing learning outcomes, managing educational quality, and tailoring education to individual’s needs.

Meeting these challenges requires a new understanding of what education achieves, and how education should be conducted. It signals a shift from process based “one size fits all” education, to highly individualised assessment of individual’s learning needs and personal development. To support these processes and assessment of learning outcomes new technological support will be needed to manage the interaction between educational systems, pedagogy, educators, and learners.

ACKNOWLEDGMENTS

The author wishes to acknowledge the contribution to this work made by Professors Mats Daniels, and Anders Berglund, through many thought provoking conversations on this topic over the last decade.

REFERENCES

Improvement of Teaching Listening English as Secondary Language Using Student Response Systems, A Case Study at King Fahd Secondary School in Albaha
Towards Informed Teacher Decisions

Ali Al-Shehri, Naif Hamed Almutairy, El-Sayed Osman
Dept. Foreign Languages, College of Arts & Humanities
Albaha, Saudi Arabia
amalshehri@bu.edu.sa, n.almutairy@gmail.com, dr_sayed_osman@yahoo.com

Mohamed Shenify, Rahmat Budiarto
Dept. Computer Science, College of CS & IT
Albaha University
Albaha, Saudi Arabia
maalshenify, rahmat}@bu.edu.sa

Abstract—This study aims to analyze empirically the enhancements Student Response Systems (SRS) can bring into English listening classes. The researchers aim to provide support to the claim that SRS provides the solution for the time, accuracy and misapplication of formative assessment in English listening classes. The sample consisted of (46) Saudi third year secondary male students from the same English level. The experiment group (23) students, used e-Instruction’s Pulse clickers and the control group (23) did not. Both groups completed five listening clicker classes. Data included pre- and post- listening tests and evaluation of students’ perceptions about the value SRS added to listening classes via an eighteen question questionnaire. Findings indicate that there is statistically significant difference at a level lower than 0.05 between posttest mean scores in favor for the experimental group. Questionnaire results report positive responses.

Keywords—Formative Assessment, English Listening Teaching, SRS

I. INTRODUCTION

Angelo & Cross argue that the quality of learning is “directly, although not exclusively, related to the quality of teaching” [1]; on which they implied that in order to improve learning, teaching should be improved. They also argued that in order to improve students learning, they need to “receive appropriate and focused feedback early and often”. Whenever teachers decide to keep track of their students’ learning, they need to “receive appropriate and focused feedback early and often”. Whenever teachers decide to keep track of their students’ learning, they need to “receive appropriate and focused feedback early and often”. Whenever teachers decide to keep track of their students’ learning, they need to “receive appropriate and focused feedback early and often”. Whenever teachers decide to keep track of their students’ learning, they need to “receive appropriate and focused feedback early and often”. Whenever teachers decide to keep track of their students’ learning, they need to “receive appropriate and focused feedback early and often”. Whenever teachers decide to keep track of their students’ learning, they need to “receive appropriate and focused feedback early and often”. Whenever teachers decide to keep track of their students’ learning, they need to “receive appropriate and focused feedback early and often”. Whenever teachers decide to keep track of their students’ learning, they need to “receive appropriate and focused feedback early and often”. Whenever teachers decide to keep track of their students’ learning, they need to “receive appropriate and focused feedback early and often”. Whenever teachers decide to keep track of their students’ learning, they need to “receive appropriate and focused feedback early and often”.

The teacher who decides to use formative assessment inside his/her class, as a technique to build knowledge using statistically informed decisions, he/she has to account for several steps and stages of building and developing knowledge [2]. According to [3], technology for solving class deficit is worthwhile. Time is one of the shortcomings of applying formative assessment traditionally. Administering formative assessment using pen and paper allows for no sufficient amount of time to finish the intended content in a single session, thus endangering the content coverage throughout the semester.

The main purpose of this study is to investigate quantitatively and qualitatively the level of enhancements Student Response Systems (SRS) can bring into teaching listening. Teacher’s views of teaching and students’ achievements are only valid if they were supported by proof i.e. detailed statistics and data that give an outline of an educational problem to be corrected or a success to be repeated. A pilot study findings by [4], showed improved teaching performance using SRS while traditional classroom assessment techniques (CATs) were 10 times slower.

This study will investigate the changes SRS can bring to the way teachers administer listening classes. Such changes are the ones that enable teachers to be well informed and get real-time readings of their class different moods and understandings. Data driven decisions by educators and decision makers are those that make use of the rich data provided by SRS.

II. LITERATURE REVIEW

Listening is an essential part of language knowledge and use. Knowledge of language involves knowledge of its grammar, rules of pronunciation (phonology), word structure (morphology), sentence structure (syntax), aspects meaning (semantics), and lexicon or vocabulary. Linguists and psycholinguistics distinguish between knowledge of the language “competence” and the use of that knowledge for listening in real situations “performance” [5].

Chomsky in [6] was challenged for claiming that language is an ‘organ’ that grows unaided and regardless of instruction,
by revolting an alternate view of language as mostly learned from experience of usage [7, 8]. Although mastery of language skills appears to be natural, but when a child struggles to learn, or an adult strives to achieve native proficiency in a second language, “instruction is essential and educators play a crucial role”. Nevertheless, what makes listening more difficult for new learners is the fact that “language use is enormously creative” [5].

Researchers unanimously agree to give the amount of listening the highest percentage over the other four skills. In this paper, the authors have synthesized listening amounts in educational situations from previous research findings in Table 1.

| TABLE 1. LISTENING AMOUNTS FROM PREVIOUS RESEARCHES |
|-----------------|-----------------|-----------------|
|                | (Wilt, 1950)    | (Rankin, 1928)  | (Bird, 1953)    |
| Listening      | 57.5%           | 45%             | 42%             |
| Speaking       | 42.5%           | 30%             | 25%             |
| Reading        |                 | 16%             | 15%             |
| Writing        | 9%              | 18%             |

A. Language Teaching in Saudi Arabia

According to the Saudi Ministry of Education (MOE) policy, the 50th article of the Saudi Educational policy inducts that Saudi students should be equipped with a second living language alongside Arabic [9]. English was made an obligatory school subject in public schools in 1979. The Saudi Ministry of Education initiated a scheme for teaching English as 4 classes (180 minutes) per week, i.e. 24 hours per year. Only after 29 years of confining English language as a school subject to the intermediate and secondary stages, MOE began in 2004 its plan to introduce English to the elementary stages descending one stage down the educational scale annually.

B. Response Systems

One of the most elaborate accounts of the history of clickers was brought by [10] where he dates their design to 1960s in Hollywood, USA. A decade later, clickers were commercialized and adapted by the business world for consultations and presentations. It was not too long before clickers found their ways into education.

The use of clickers gave instructors a clear line of sight to the level of knowledge students had. The lack of that knowledge may hamper their understanding [11]. Throughout educational methodology, no medium can be compared to technology when it comes to promoting active learning, except good instruction. Collins, et al. [12] argue that today’s students are more interested in learning in an engaged environment.

Davis [13] claims that the best way for students to learn is when they are active participants in the learning process. Survey of literature shows that “most research on the benefits of using clickers in the classroom has shown that students become engaged and enjoy using them” [14]. The Association for Supervision and Curriculum Development (ASCD) authors [15, 16] debate that the use of appropriate technology tools to accomplish learning goals meets the needs for the 21st century students. Students showed noticeable achievement improvement on standardized tests after using technology [17].

The main goal of using clickers is to enable students to get to know how well they are doing. Learner’s metacognitive knowledge about listening affects the outcome of their listening comprehension. Research shows that next to improved achievements, students’ behavior improved with greater interactivity and engagement in the learning process [18]. Clickers specifically increase participation among students and help identifying and correcting misconceptions.

Clickers also provide anonymity which is an added value feature. Such a feature guarantees a near or total participation [14]. Learners who have the opportunity to “monitor and evaluate what they do” have better outcomes.

Authors in [12] all agree in their research reports that the use of the new clicker technology can be used to; enhance questioning and feedback, motivate students, monitor participation and make students’ thinking more actively.

A final note would be that regardless of any technology used, “the research to date seems to suggest that how the instructor makes use of the clickers, rather than the simple adoption of clickers themselves, is what determines their pedagogical effectiveness” [19].

III. EXPERIMENT METHOD

The experiment method consists of two main parts, subjects and design. It will begin by describing the population with specific detail on how sampling took place. Then, more description of the instrument used is detailed to measure its effectiveness. Following that, assessment is proven as bias and free of distortion through reliability and validity measurements. Scoring and statistical methods are illustrated.

This study asks the following questions, (1) Do third year secondary students in King Fahd Secondary School (KFSS) achieve better results in the posttest when taught listening using clickers? (2) Do third year secondary students in KFSS taught listening traditionally without the use of clickers display similar outcomes to students taught listening using clickers? And (3) Do third year secondary students in KFSS prefer to attend classes where clickers are used?

The independent variable of this study had an experiment condition where students were taught listening with the use of clickers and a control condition where students were taught listening without the use of clickers.

All the data were collected during English language classes in the first semester of the academic year 1434-1435 H corresponding to 2013.
A. Research Population

This study was conducted with a population from the third year secondary students at KFSS. All the subjects are males from Al-Baha City and their mother language is Arabic. At the time of this study, students in the secondary stage had the choice of four majors, Arts, Administration, Sciences or Technical. All the subjects in this study were science major. Furthermore, regardless of their major, students were supposed to have had exposure to English language as a school subject for seven years throughout their school years. Research subjects also studied English language alongside other school topics. They constitute 20% of the entire population of KFSS.

Subjects in both experiment and control groups were equal in number, major, grade and school. Since all subjects shared the same educational background, their English levels were presumed as homogeneous. The total number of students in this study was 46 students; 23 experiments and 23 control.

B. Sampling

Following a randomized design suggested by Dimiter & Phillip [31], participants were randomly selected, randomly assigned to groups and randomly assigned to treatment. No extra credit, marks or benefits were awarded for participation in this study, neither for the experiment group nor the control group. Consequently, all students in the study were asked to sign an informed consent statement to allow for the use of their data in research.

KFSS is one of the elite and award-winning schools in Albaha region. The clickers used in this research were provided freely and unconditionally by the school's administration. The school had a stock of 180+ clickers, Hence, insured the study data collection to be efficient logistically. Data collected via clickers were representative of their users because all the subjects in this study were used to the use clickers in both exams and regular classes. Thus, they needed no extra help operating their own clickers and registering their own desired input.

To ensure a bias drawing of inferences when interpreting statistical results in a valid and accurate manner, Johnson [32] suggests that the data collected should be in "the normal - bell-shaped - distribution". Thus, allowing future values big or small to be less likely to deviate from the central value.

Upon analysis of the distribution of the pretest data set of this study, it showed that the propriety of data distribution is centered on specific values and that further observations are expected to follow the same range. Most of the results of subjects ranged in two bin limits, 18 and 19 as seen in Fig. 1.

With Fig. 1 parameters, the Bell Curve grade scale reflected that one of students received an A grade with a score between 19 and 18.78. But, six students received a B with a score between 18.78 and 17.24. Majority of the population, 29 students, received a C with a score between 17.24 and 9.76. Also, six students receive a D with a score between 9.76 and 8.22. Finally, only one student received an F with a score between 8.22 and 8. Such results reflect a normally distributed data with 68% of the population around a central value showing that the scores do not vary from each other, on average.

C. Experimental Design

As stated in the sampling section, the two groups were researched in a random design. After the random assignment of groups, pretest and posttest were assessed. The assessments are represented in Fig. 2 as \( O_1 \) and \( O_2 \). \( X \) refers to the treatment condition while \( X_c \) represents the standard treatment condition.

Comparison of experimental and control groups were on the difference between posttest mean and the pretest mean gain scores. Pretest and posttest were administered in the same time. Also, all the treatment classes were administered in the same time, too.

The experimental group was exposed to five clicker treatment sessions based on listening enhancement resources for five weeks then was compared to the other group that did not receive treatment.

Material for listening enhancement was adopted from English language listening skills Podcast, freely available online from learnenglish.britishcouncil.org.

In both groups, participants were seated in individual desks. A computer connected to an overhead projector presented stimuli over sound speakers at a comfortable listening level. Experiment group responses were collected via the students response system (clickers) into one USB dongle that recorded electronic signals and later represented them in excel spreadsheets assigning every click to its original user. Control group submitted their responses manually.

All listening activities required students to make choices, fill tables, underline sentences, pick pictures, determine the truth, choose all possible correct answers, complete T-charts, follow route on a map, and take notes.

Treatment revolved around using the audio/text material and mirroring it with a response programming scheme using e-Instruction’s software "Test Builder®". The software preprograms all the questions the instructor intends to use in his class in advance, making it extremely easy for the instructor to administer quizzes. By clicking "load test", the software
The research independent variable is the implementation of clickers, while the dependent variable (covariant) is the score results, which is made of two conditions:
1. Experiment condition, teaching listening using clickers.
2. Control condition, teaching listening without using clickers.

Statistical measurements were applied to show the homogeneity of the two groups. Finally, more correlation measurements of the posttest of both groups were illustrated. After stating the correlation factors, it is time to discuss the research questions and hypotheses. Significance of differences was examined via T-test and Levene’s test. The software used for analysis was Statistical Package for the Social Sciences (SPSS). A large mass of social sciences used SPSS software to run research statistics.

**Experiment Group vs Control Group Results**

Analysis of the pretest means of both control and experiment groups was inducted to ensure that both groups have homogenous levels of language proficiency. The control group was 3.22 and the experiment group was 3.17, and the difference is statistically marginal. Posttest means analysis of both control and experiment groups was inducted to examine if both or any groups have elevated levels of language proficiency after application of treatment. While the posttest of the control group mean is 3.26 the experiment group is 7.26 which is extremely higher than the control group.

Applying T-test to see the significance between the two means of the pretest and the posttest of the control group, it was revealed that the significance level is far more greater than 0.05. The correlation between the pretest and posttest was not statistically significant as (r = 0.043, p > 0.05). Therefore the research null hypothesis, “third year secondary students in KFSS taught listening traditionally without the use of clickers display similar outcomes to students taught listening using clickers” was rejected. Furthermore, Levene’s test for equality of variance is at the significance level of 0.733 for the pretest. All of the above data are assumed with equal variance, nevertheless, with equal variance not assumed, the significance level is still fairly low between the two. Levene’s test for equality of variance is at the significance level of 1.000 for the posttest with assumption that the data are equal variance.

**A. Questionnaire Analysis**

In this research, the responses were designed via Likert scale. Testing the null hypothesis that states “third year secondary students in KFSS do not prefer to attend classes where clickers are used”, the frequency, percent, and mean were used indicate that students reflect positive attitudes towards using clickers, where the total percent of agreement was 62%.

**IV. EXPERIMENT RESULTS AND DISCUSSION**

The research independent variable is the implementation of clickers, while the dependent variable (covariant) is the score results, which is made of two conditions:
1. Experiment condition, teaching listening using clickers.
2. Control condition, teaching listening without using clickers.

Item 15 in the questionnaire was stating “I would prefer to take a class that uses this system over one that does not use the system” scored the highest mean value of 4.24 constituting 85% of relative weight. Such a result voided the researcher’s null hypothesis “third year secondary students in KFSS do not prefer to attend classes where clickers are used.” Students prospective of items seven regarding the time allocated to answer the question stating “the average time you like to have to answer a question is enough”, was the lowest in the questionnaire at the mean value of 2.78 constituting relative weight of 56% (see Table 2).

**V. CONCLUSION AND FUTURE WORK**

The results of this study lent support to the nullification of the first and second null hypotheses, third year secondary students in KFSS do not achieve better results in the posttest when taught listening using clickers; and third year secondary students in KFSS taught listening traditionally without the use of clickers display similar outcomes to students taught listening using clickers. No evidence was found to support them. This result is consistent with prior studies that indicate that by using clickers students show improvements.

The third hypothesis, third year secondary students in KFSS do not prefer to attend classes where clickers are used, was not retained after analyzing students perceptions about the technology. Students felt that the technology was user-friendly. This result is similar to reports of previous research that indicate that student feedback toward the use of clickers was positive.

In the present study, another unsung benefit for using clickers was that participation has increased to 100%. Moreover, by comparing participation charts before and after the use of the technology, what was thought of as medium students, showed increased participation. Future research can further expand the comparison.

**REFERENCES**

TABLE II. QUESTIONNAIRE FREQUENCY, PERCENT, AND MEAN

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<td>18</td>
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<td>3.33</td>
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</table>

Total | 232 | 3.66 | 73% |
Data science and engineering education at the IT Department of Uppsala University

Matteo Magnani
Dept. of Information Technology
Uppsala University, Sweden
Email: matteo.magnani@it.uu.se

Abstract—This paper describes current teaching practices in the area of data science and engineering at Uppsala University, from the high level relationships between different courses to detailed lecturing methods and examination approaches. Specificities of discipline-based education in this area are also highlighted.

I. INTRODUCTION

Data management is a foundational aspect of Computer Science and Engineering. While database systems have always been part of IT curricula, the importance of data-centered courses has increased in time thanks to the higher availability of large and commercially valuable datasets like the ones generated by Web 2.0 and more recently Social Media applications. This has led to the emergence of a new professional figure capable of dealing with all the phases of a data management process, from its collection to its long term storage and analysis. This figure is often referred to as data scientist, but is more accurately described as data scientist and engineer to emphasize the strong engineering skills needed to deal with large amounts of data. As a consequence, several universities have recently developed specific educational plans, including master programs1,2,3.

Education in data science and engineering has some specificities if compared with other areas of IT. While the diversification of student populations is a well-know challenge of modern academic education [1], and I am not addressing this general problem in this paper, it is worth mentioning that some data management courses (and in particular introductory courses on databases) are affected to a higher degree by this factor. In Uppsala, these courses have been designed to be delivered to a very wide range of students, spanning a number of disciplines from Science and Technology to the Humanities. This, together with increasingly more frequent multi-cultural classrooms, determines very heterogenous student backgrounds, student levels and expectations, requiring a strong usage of multiple lecturing styles, types of content and additional learning resources. In addition, a data scientists must go beyond the technical aspects of data management. While non-technical topics can be addressed in other courses, it is important to keep a broad perspective also inside courses more focused on IT and systems.

Given the vitality of the area, it is difficult to present a well-consolidated view of it. Education, not only the data-centered one, is continuously evolving, for multiple reasons: to include recent technological innovations; to react to societal challenges defining social priorities, e.g., an increased sensibility towards green computing, or an increased preference towards algorithmic features like privacy preservation; to experiment new methods, both in lecturing and assessment; to increase the amount and quality of the material made available to the students; to motivate and engage the course staff; to adapt to changes in the student profiles; to adapt to changes in the study programs involving related courses. Therefore, the following should not be intended as a static or dogmatic picture, but as a short-term liquid plan which will continuously change.

To put the content of the paper into the right context, I will first provide a brief overview of the different courses in the data management area. Then, details and examples concerning lecturing methods, role of labs and practical exercises, development of non-technical competences and examination approaches will be presented focusing on two of the courses: Database Design I and Data Mining I.

II. CORE COURSES IN DATA SCIENCE AND ENGINEERING

It is difficult to draw clear boundaries between courses belonging or not to the area of data science and engineering. Therefore, I will focus on a set of courses that for historical reasons have been strictly linked together, indicated in gray in Figure 1. Arrows indicate logical prerequisites. The basic course in the area, Database Design I, covers relational database management systems. From the figure, it can be noticed how this course does not directly depend on other courses providing basic knowledge about technology, e.g., computer architectures (even if formally it requires free credits in Mathematics and Computer Science, including basic programming). This is a result of the aforementioned heterogenous student population, including the need to serve study programs like Biotechnology where students lack a strong background in IT. Therefore, the material about database systems has been split among this course (all about designing and using relational database systems) and the Database Design II course, where the internals of the systems are studied together with other database models. In this way, the requirements for deeper knowledge in Computer Science and Information Technology only apply to the Database Design II course, which is typically chosen only by those people wanting to focus on these aspects. The Data Mining I and II courses are structured in a similar way, where the former focuses on relational data and the latter on other kinds of data or advanced algorithms. Advanced Database and Data Mining courses are very related

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1http://datascience.berkeley.edu
2http://www.cmub.edu/graduate/data-science
3http://www.sobigdata.it/master/bigdata
and expected to interact with other courses, covering aspects like parallel computing (e.g., how to execute data mining algorithms on a large scale) and Machine Learning (providing alternative algorithms to solve common problems).

As database systems are often a fundamental component of more complex information management systems, they are also used inside project courses where the knowledge coming from these and other courses is integrated and applied to solve real of realistic problems.

III. TEACHING METHODS

Teaching, as well as the course organization, is also influenced by the heterogeneity of students attending the courses. This requires a broad repertoire of teaching methods and principles to be applied, summarized in this section.

A. Planning

Course planning starts long time in advance before the course begins, normally a few months. Apart from basic bureaucratic needs like planning the number and type of activities and allocating the corresponding resources, like rooms and mentometers (clickers), the course staff is selected and involved in the course preparation. In addition to informal interactions with the course assistants, several structured meetings are held: before the course, to agree on its structure, plan all the dates, activities and assign responsibilities, after each course assignment has been released, to discuss potential solutions and agree on homogenous evaluation criteria, after student submissions, to correct part of the assignments together (again, to achieve a uniform evaluation), and after the course, to get feedback and plan future actions. Motivation, and feeling like being an important part of a well organized educational project, is very important for the engagement of the course assistants.

B. Anatomy of a lecture

Lectures still represent a large portion of many courses, even if more labs and practical activities are being added, because of the importance of teaching the conceptual and theoretical bases of data management.

The first part of each lecture (or related set of lectures) often follows a common structure. Lectures normally start recalling the big picture, that is, the general plan for the course introduced during the first lecture, and showing what part of this plan corresponds to the current lecture. Signposting [2, pg. 704] is also used abundantly later on. Then, the Intended Learning Outcomes of the lecture are briefly discussed. While this is typically considered an important part of a lecture, the beginning may not be the best time to present them, because they can be difficult to understand before seeing the corresponding content, and they can also risk to ruin the story of the lecture, in case the lecturer wants to keep some suspense about the solutions proposed later. Therefore, the students are often reminded to go back to them after the lecture as a guideline for their study. They are of course also recalled at the end of the lecture, while wrapping up. Finally, all lectures include an initial motivation of the content, to convince the students that it is worth paying attention to it. This can be done in different ways, either by providing references to the real world, anecdotes, or by involving the students in activities and/or discussions where they realize themselves the importance of the topic.

Here are some examples. If the objective is to show the importance of relational database management systems, one thing is to tell the students that these systems are very widespread. Another potentially more effective way is to ask them to think of a typical activity, for example buying a Ferrari on eBay, and trying to find how many relational systems they have used at the end. In this way, the course content becomes linked to the students’ everyday life. If the objective is to understand the importance of integrity constraints to guarantee the quality of the data, one thing is to say that they are important. Another more effective way is to give some data to the students and ask them to vandalize it, making it inconsistent, to highlight how most of their actions would not be allowed by a well-designed database.

The main material is then presented, when possible in multiple different ways. For example, to explain how a Normal Form works, its intuition is provided, then its formal definition is stated, then the students experiment themselves with it on an in-class exercise, they discuss some of their different solutions, the main outcomes of the exercise and discussion are summarized, and students answer one or two quizzes using clickers. The main objective is to provide different kinds of students with their preferred way of learning.

Learning styles do not only involve preferred types of activities to learn, but also preferred senses. For example, many questions are given in the think-share-pair format, where students are first asked to think of an answer individually so that impulsive repliers give time to students who need to internally elaborate the concept to do so, then people have an opportunity to talk about it, and (if necessary) to discuss about it. As stated by a student in a recent course evaluation:

[...] all the different ways of learning were in the lectures. Some people learn best by hearing, some by discussions, some by acting, see and move. All these techniques were covered! :D [SIC]

Apart from the importance of using different approaches to accommodate different learning styles, this also creates some variety which may prevent the students from getting bored.

\footnote{A Normal Form is a set of formal requirements that some data must satisfy so that specific types of data inconsistencies cannot occur}
9) Would you like having more 1-minute breaks during the lectures?

![Bar chart showing survey results]

14: Did you find the 1-minute breaks useful? Answers: 56

<table>
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</tr>
<tr>
<td>3.</td>
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<td>14%</td>
</tr>
<tr>
<td>4.</td>
<td>6 responses</td>
<td>11%</td>
</tr>
<tr>
<td>5. Yes, to a high degree</td>
<td>32 responses</td>
<td>57%</td>
</tr>
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</table>

Fig. 2. Evaluation of 1-minute breaks without and with explanation to the students (respectively, course on indexing disk-based data, Aarhus University, Denmark, 2011, and Database Design I, Uppsala University, Sweden, 2013)

Two important teaching tools used in multiple contexts are clickers and silence.

[... clickers [...] keeps up the interest. I also like the 1 minute breaks.]

Clickers are used to perform different kinds of activities. Their main role is in supporting continuous assessment (quantitative polls), so that after expressing some concepts it is possible for the teacher to check if the concept has been understood and either continue or go back to the material, depending on the number of correct answers. This has also the positive side-effect of raising the attention level, which is the first step in a successful learning process – where successful is related to the ability to retain the learned information in time [3]. Another typical usage concerns those cases where it is not possible to identify one single correct answer (qualitative polls). In these cases, the answers typically polarize on two or more alternatives, from which it is then easier to start a discussion asking the different groups of students to support their opinions. Another may be not very interesting but practically useful usage is during tutorials, where students provide feedback regarding their advancement (e.g., clicking on the last task number they have solved) and the teacher can know when to proceed, or when to provide feedback in case part of the class gets stuck at some specific place.

Silence is also an important part of the lectures. It is sometimes used in a structured form, introducing one or two one-minute breaks during each 45-minute lecturing session where students can stretch, relax, talk, think, etc. According to my student evaluations, this is appreciated by most students if the reasons behind it have been explained to them – specifically, the attention curve and their efficient participation. Otherwise, there can be students liking it (just because they feel good) and other students not liking it intellectually, because they think that this reduces the amount of information the teacher can transfer to them. It is thus important to briefly explain to them that this is not how students generally learn, as suggested by the final evaluations in Figure 2. In addition, silence can be useful as a rhetorical tool, to create tension, or to recall attention, or to give students time to consolidate what has just been presented.

The different teaching tools briefly described so far are then packaged into more homogeneous macro-types of educational sessions matching the different kinds of content taught during the course. Five main kinds are currently used, from the larger pool of options in [2]:

1) **Traditional lecturing**: some topics require detailed explanations. As an example, the explanation of how specific scheduling algorithms support the concurrent execution of multiple programs manipulating the same data (transactions). While long lecturing time is preferably avoided, and mixed with some of the aforementioned activities, some 15-minute-long lecturing blocks may sometimes be the best way to teach some content.

2) **Example-based**: the two lectures on conceptual data modeling are made of a single 4-hour-long modeling example, where student groups receive a paper with the specification of a reality to turn into a diagram. The example is split into small tasks, preceded by a very short introduction to the components of the diagram needed for the specific task.

3) **Tutorials/Flipped classrooms**: this is used for example in the lectures about SQL. The difference with the previous macro-type is that here exercises are solved based on previous knowledge, acquired through brief lecturing sessions or at home by individual study, which is then applied and tested. In Example-based sessions knowledge is acquired during the session.

4) **Labs**: some topics do not require any lecturing effort at all, and are thus addressed by asking students to solve practical tasks in the labs. These have gained more importance during the evolution of the courses, and in some cases they can become the single strategy adopted in a whole course [4].

5) **Assignments**: These tasks, often executed partially independently and partially under the supervision of an assistant, are at the same time examinations and opportunities to practice previously seen content, or to complement it. More details on assignments are provided in the next subsection.

Finally, multiple sessions are aggregated to address larger chunks of the courses. As an example, the course section on database conceptual modeling is composed of two lectures (where diagrams, concept and methodology are introduced, example-based, 4 hours), some individual study time on provided exercises with solutions (around 2 to 4 hours recommended), a more complex real assignment (around 10 expected hours of group work) plus the corresponding feedback meetings and discussions with a tutor.

C. Labs and practical assignments

Two types of assignments are currently used. One to learn the concepts, made of simple tasks designed to guide the students step by step, and one presenting some real (or realistic)
tasks, to develop the students’ ability to independently apply their knowledge. The latter is of great importance in data-centered courses.

Focusing again on the database conceptual modeling example, two recently used assignments of the second type consisted in modeling respectively a database for the European Patent Office, storing information about the patenting process, and the European Protein Data Bank, storing information about the structure of proteins and the corresponding scientific literature. As said, the objective is to test the students’ knowledge on a realistic scenario, to prepare them to deal with the real world. Differently from typical academic examples used to learn conceptual modeling constructs, real specifications can contain redundant, vague or even inconsistent information, they can refer to a topic students’ are not familiar with and be long and complex. Therefore, a traditional presentation of conceptual modeling can be insufficient and misleading. This has been verified multiple times at a later stage of education, where students successfully passing a Database Design course found it difficult to apply those concepts during their master’s thesis projects.

The other kind of assignment is typically designed to fit one 2-hour lab and in some cases it replaces material previously part of a lecture, e.g., embedding SQL in programming languages (which does not contain particularly challenging knowledge needing an explanation by the teacher).

Assignments are performed in groups, partially because of resource management – so that each group can get enough support by its tutor, partly to take advantage of the positive effects of the social context on learning, an aspect that is also exploited during active classrooms and has been long recognized in the pedagogical literature [5].

The assessment of data management courses has been strongly influenced by outcome-based education (OBE) [7]. The written exam of the Database Design I course is currently based on learning outcomes, where tasks belong to two categories: pass, concerning practical abilities of solving basic problems in the different areas of knowledge of database systems, including conceptual modeling, relational modeling, normalization and SQL, and advanced, requiring the solution of more complex practical problems and also involving theoretical knowledge. A combination of different types of questions is used depending on the tested knowledge [6]: open questions, practical tasks and multiple-choice questions. Passing questions are important to ensure that a student passing the exam is able to solve basic problems in all the most important steps of database design and management.

However, this type of examination alone is limited, particularly in this domain. Constructive alignment [1], which is a type of outcome-based education, seems to be a fashionable asset of educated teachers nowadays, but it can be easily misused. Data management courses are designed to prepare the students for life, not to pass the exam. Life will seldom present the same challenges found in the course syllabi, and also involves high-level competences not easily described by a simple verifiable learning outcome. Instead of just aligning the exam to the course content (which is also done, to some extent) I personally prefer to motivate the students to learn because they like the topic, and to give them some tasks related to the course that they were not specifically trained to solve. Technically, this can also be called constructive alignment, but it is a less precise version of it partially giving up the need to test a clear set of outcomes and trying to put the students in a less structured context. It is worth noticing that critiques to the general principles behind OBE abound, apart from my personal point of view [8], and in my personal opinion they are particularly relevant in the context of data management education.

Two typical examples of more complex and not-so-aligned examinations are the aforementioned conceptual modeling assignment, and the data mining project, where students are given some real, large data with almost no directions, and are asked to do something with it applying their knowledge of data mining.

As an example, a group of students from the last edition of the Data Mining I course tried to classify the risk of post-traumatic stress disorder in veterans of the US army, starting from census data provided with no further explanation or requirements. This kind of activity went far beyond the simple application of Data Mining algorithms, connecting data analysis with societal issues, reasoning about different kinds of knowledge that can be hidden in the data, keeping a view over a big picture, and also applying a number of tools and concepts learned in other courses, like the usage of a relational database to store and pre-process the data.

IV. Conclusion

To conclude this brief description of how data science and engineering is taught at Uppsala University, providing a certainly partial but hopefully insightful presentation of our current educational practices, I would like to summarize some characterizing aspects of teaching this discipline. The large student variety, higher than in other IT courses, leads to strong requirements in the course dependencies, so that each course can fit its intended audience. The discipline also requires a delicate balance of theory and practice, and necessitates to include experiences involving real (or at least realistic) tasks.

REFERENCES

Enhancing Ethics in the Computing Education Curriculum

Faroq Ahmad
College of Computer Science & Information Technology,
University of Al Baha,
Al Baha, Kingdom of Saudi Arabia
drfarooqa@gmail.com

Abstract—although ethical understanding and its following is essential for every member of a society it becomes more crucial for professionals in general and Computing Professionals in specific. Recent literature has many reports on the misuse of ICT and the unethical or misconduct of Computing Professionals. The work tries to identify the specific reasons why Ethics Education is essential for Computing Professionals. After reviewing models and factors of ethical development in general, the work proposes an integrated ethical development approach to be incorporated in the Computing Education Curriculum. The approach on one hand emphasizes the value based ethical development of students to enhance the personality and the values are generic in nature and would need the judgment of the individual in application. On the other hand it suggests course specific case-based contents to be taught to the student to prepare them for the agile issues specifically arising in the technical areas. The work would also propose the establishment of a National Centre for Ethics in Computing at Al Baha University.

Keywords—Computer Science Education, Curriculum Development, Ethics, Ethical Aspects.

I. INTRODUCTION

The objective of the professional education is to produce graduates who are competent in their profession and would use their competence for the welfare of the society. While we teach for competence at the professional education level we ignore ethical development of the graduates. It is strong ethical development which will compel the professionals not to be selfish rather to use their competence for the welfare of the society in general.

The paper discusses the importance of ethics for computer professionals. Then it highlights some of the misconducts commonly committed by the computer professionals. It also describes some of the possible misconducts which may not be visible to the general community.

An outline of the Integrated Ethical Development Approach is presented. The approach suggests incorporating ethics at two levels in the curriculum for computing professionals at higher education. One is to include explicit contents on various ethical values in the courses. The values selected should be in accordance of the priorities of the local social setup. Secondly to incorporate the technical domain specific ethical issues as examples and case-based in the respective subjects. The approach is also suggesting on defining and adopting policies for the academic institutions to enhance the ethical development of Computing Professionals.

II. ETHICS AND COMPUTING PROFESSIONALS

Understanding of ethical values is more important for Computer professionals [4] and unethical behaviour of computer professional bear drastic results [13]. Therefore, many works like [14] strongly suggests research in ethics in CS education.

Importance and relevance of ethical development can be looked into in the context of the following three concerns.

A. Wide span of Application

Computers have a wide span of applications compared to other professionals like medical doctor, engineer etc who would mostly be engaged in a specific field. A computer professional has a variety of fields to work in, from hospitals, constructions, banks, general administration to industries of all types. Whereas understanding of code of ethics may be useful/helpful/sufficient for other professionals, it may be difficult to comprehend the roles a computer professional have to play in a single code of ethics [15]. Rather the usefulness of Code of Ethics has been questioned by many studies even in other professions [16].

B. Enormous Growth with Unprecedented Speed

The growth of ICT has been enormous in a short span of time. A relatively slow pace of development has given other professionals a time to understand the social and ethical dimension of their technology/profession. While in ICT sometimes new developments bewilder even the experienced professional on ethical decision making [2].

C. Lesser Interaction with Humans

Perhaps the most important aspect of computer professionals is their lesser interaction with humans. Most of other professionals interact regularly with people. Their unethical behavior or attitude can be observed easily and quickly. A remedial action or a shielding effect can be adopted. As computer professional work mostly with or through computers, their unethical behavior or attitude may go unnoticed long before it may be remediated or shielded from.

III. CASES OF MISCONDUCT OF COMPUTING PROFESSIONALS

“We live in a time when our understanding of the role of the teacher and the power of Values Education are coalescing. No longer is Values Education on the periphery of a
Various studies show that the ethical development of our students and graduates are declining [1], [8]-[11], [22]-[24], [31]. Technological development is making ethical issues more prominent [2]. Keeping in view the situation UN and UNESCO has to start special "Ethics Education Program" [25], [26]. The European Universities and other European association had to arrange a conference to put a declaration on the ethical development in higher education [2], [27], [30]. The establishment of Code of Ethics by almost all professional bodies is also an indication that there has been violation [38].

It is common to see computer professional violating ethical values in their professional work. Data and privacy violation is quite frequent. Literature [1], [4] reports many such cases. Similarly misuse of authority is also reported frequently. Similar cases which may be visible to the commons are many. Let's look into the situations which are less observable to the non-technical people. Many of them can appear in the software development and related activities.

Software development is a creative activity like poetry and painting etc. In spite of different techniques for measuring the productivity of a developer [4] the time frame given and used by the software developer depends to a greater extent on the moral attitude of the developer whether he is wasting time or really putting all his efforts.

Software engineering literature is full of cases of the failures of software projects. It has been reported that up to 24% of software projects are abandoned [21]. Does software developer feel the same guilt would be felt by other engineers and developer if they had the same high rate of failures?

Software patches or corrections are common even in quite popular software after releases. Does the software developer feel the moral obligation not to deliver product until full satisfaction that the product is free from any faults and that the product will be up to the satisfaction of customer?

Customer are pushed to buy new version of software although the existing software more than enough for my needs. The push for the new version maybe because the company released unfinished product just to beat the competitors or maybe wants the customers to pay again for the software or maybe they are stopping others to develop further components for the software. Is it ethical to release a software whereas it is known that new features will be added soon?

The size of the software is increasing exponentially from early times of kilobytes to gigabytes. How much of the source code in the software is rubbish - leftover of various tests and unused statements.

Similarly we all witness that using a computer continuously for long time the hard disk accumulates rubbish left by the software executed each time. Whose moral responsibility it is that this rubbish should not be created and should be cleaned on the termination of the software?

IV. ETHICS EDUCATION IS ESSENTIAL FOR COMPUTING

If we look to the various professional programs, in general, they emphasize two aspects of graduates and professionals, i.e., to be technically competent and beneficial to the society. Benefit to the society is associated with the understanding and binding of ethical values [17], [18]. If we look to the curricula of Computer Science programs, 90% of courses are targeting technical competence and managerial issues [19]. ACM/IEEE curriculum Task Force is recognizing the importance of ethics and has defined a Knowledge Area "Social & Professional Issues" [19]. Still it is too little as compared to the important role ethics play in the professional life of Computer Professionals. Our education system is not ready to take care of the deficiency of ethical development [20]. In general very little is given and taught to persuade the student how to use the technical competence for the benefit of the society. It would be perhaps enough to teach a course on professional ethics if the assumption that the basic ethical development of the student has been done at the earlier stage of student's life was correct [18]. As already mentioned that has not been there. In such a situation, does a course on- ethics, professional ethics, or code of ethics suffices the job [16]?

Therefore, the work suggests that although the requirement is general but specially for computer students we need to provide more understanding of ethics [3], [4] not only on professional ethics but ethics in general or human ethics.

V. MODELS AND FACTORS FOR ETHICAL DEVELOPMENT

Ethics is the formalism of interaction and norms in a society. Societies develop ethical values to let the members cooperate for a smooth and happy social environment [29]. How do members of the society learn and adopt those values? The sources can be divided into three main categories i.e., the family & friends, members of the society/community in general, and the formal education. The role of these sources has been changing in the near past drastically regarding the ethical development.

The first learning place is the family for every child. The basic moral values are learned by example and explicit "told off" from the family. Mother, father and siblings play a major role in the moral development of child. Next comes the friends and near relatives with whom the child interacts. These interactions and give & take mold the character of the child [1].

When the child grows and goes out of home he learns from the people around in the community. What he sees on the road, in the shopping malls, in the play grounds and in the community centers like places of worships is absorbed by the child. These interactions shape the ethical values of the child [11].

The third source is the formal education systems. From the KG to the university what the student is being taught about the ethical values and the importance of the binding to these values. In the formal education main role is played by the character and attitude of the teacher [22], while contents of the
material being taught and the environment & policies of the institution are the other major factor.

Now let's look into the status of the three sources of ethical development.

Family systems are breaking and have reduced to only mother, father and siblings. Parents don't have time for the children. It's becoming rare to see the family sitting together. Everyone is busy with their own gadgets. As indicated by [23] children are not learning values at home & schools and they don't understand ethical issues.

The societies are becoming individualistic and not only interactions are reducing but guiding and prohibiting of a child is disappearing from the society [31]. Modern communities play minimal role in the character development of a child and even do not feel responsible for that.

Although one of the objectives of education is character building [22], [31] unfortunately formal education has almost no contents for ethical development. The college and university level perhaps feel it's not their domain [18]. At the early ages of child also unfortunately the moral lessons and stories are disappearing (rather disappeared) from schools and even preschool teaching material [28]. Some studies [1] indicate that some moral values even deteriorate with the university level education.

In general, apart from various other factors, the disappearance of ethics can be attributed to the Scientific Approach [25], Economic Push [18], Quick Outcome and Diminishing Family Systems [28].

Therefore, none of the basic sources of ethics and character development is playing their role adequately [28]. In such a situation when the students/graduates are not developed in the basic ethical values. Teaching them just a course in professional ethics or teaching them a professional code of ethics cannot bring the ethical understanding and binding required for the welfare of the society [16].

VI. FOCUS OF OUR WORK

The work is not concerned only about the Technoethics or the Professional Ethics. Both of them have their own place and importance. With the changing world, advances in technology, emergence of newer professions, and new professional issues, definitely there is a need for the enhancement and understanding of all these ethical values [29]. But the issue is will it work when we have not prepared the foundation for it. Graduates lacking the basic ethical values, would they value these lessons in professional ethics or the spirit of code of ethics [16]? The study is emphasizing that understanding of basic ethics has to be inculcated in the computing professionals [3]. Ideal would be that the younger generations are equipped with ethical values from the childhood at home, community and schools. But in the absence of that the last hope remains with the professional education. As suggested by many researchers [16] ethics can still be instilled at the adult age and in undergraduate programs. Lovat [22] explains the "Double Helix Effect" of education and ethics, if we can instill ethics in the student it will improve the technical competence or learning of the student as well. The computing curriculum has to take care of ethical development. Although technical competence is important, covering of all contemporary topics are necessary but graduates lacking ethical values become useless to the society [1]. Their competence may be useful for themselves but at times may become even dangerous for the society.

One concerning issue is, what are basic ethics? As already discussed many of these are dependent on ethnic beliefs and local community traditions etc [15]. But still we can identify universal basic ethical values [3]. Colby [18] has derived the basic values from various codes of ethics. Similarly Ali [1] identifies the ethical values concerning the academic environment. In fact the variations are mostly in the extent or emphases and in the details. One community gives more importance to one value than another. These can still be left to the local environment.

VII. INTEGRATED ETHICAL DEVELOPMENT APPROACH

A. Ethics at Higher Education Level

The work is recognizing the importance of ethical development for computing professionals and also the fact that the factors which could play a role in the ethical development of the student have not played their role efficiently. Now this is the last step before the student would become a professional and join the practical life of society as a professional. Therefore, as suggested by [22], [33] and [34] it is strongly recommended to use this opportunity and incorporate ethical development as an explicit effort in to the curriculum at higher education levels. There is a chance that it may be more effective because the students/professional have more mature minds and appreciate this effort.

B. Complete Personality Development

The work is emphasizing on the complete personality development. It is not opting for academic ethics i.e., not to copy, plagiarize etc. nor for just professional ethics. These are auxiliary issues and would be effective only when a proper base is present. The target is to produce graduate who understand and practice the basic ethical values. The ethical values which the society upholds recognize and stand for.

C. Integrated Support for Ethics

The ethical development has to be integrated into almost all the courses offered to the students and through an ethically conducive environment of the academic institution. The ethical values should be spread over various courses. Some can be in terms of relevance and some even at random. The academic institutions should adopt policies where they high the ethical values they are concerned about [36], [37]. Teachers should be trained to observe and evaluate students for ethical development beside the technical knowledge they impart. It is even suggested that Ethical development and its performance should be included in the formal evaluation system.

D. Values Development with Specific Technical Domain Application

The ethical development at the professional level should be in two categories as suggested by [29] i.e., ethical values and subject specific technical domain understanding of ethical issues. The ethical values should be selected according to the social setup. These values can be incorporated into various
technical and other subjects, explicitly mentioned as the particular value [16].

 Majority of the professional subjects have their own ethical issues. They should be treated inside the respective technical domain, for example the ethics of software design, ethics of programming, ethics of databases, and ethics of network administration. Subject specific understanding of ethical issues and applications should be taught through case studies and examples.

VIII. CONCLUSIONS

In this work a case has been presented that understanding of ethical values and their binding is very important for all professionals in general but it becomes more critical for computing professionals because their interactions are mostly with machines and the visibility of unethical behavior is lesser and delayed. At the same time the technology is changing so fast that everyday computing professional are faced with new ethical issues. For the prosperous and happy development of society ethical behavior play a major role. It is also shown that teaching a course only on professional ethics or code of ethics is not very useful, because the students are lacking the basic understanding of ethics. The early life sources of inculcation of ethical values from the family, community and early education are significant for the development of the computing professionals.

The work is proposing an Integrated Ethical Approach where the undergraduate curricula of computing should take care of this deficiency. They should incorporate explicit contents on ethical values in various subjects. At the same time the technical subjects should have respective examples and cases of handling ethical issues specific to the domain. The work is also suggesting the academic institutions of computing profession should come up with special policies to make the institutions environment conducive to ethical development of the computing professionals.

At the end it is proposed that Al Baha University should step forward and establish a National Centre for Ethics in Computing Profession. The university will not only become a leader in the region but the only one in the world. It is proposed that the centre will continue further on the various issues of Ethics in Computing.

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