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FOREWORD

It is with deep humility and gratitude that I share in the proceedings of the **EduTeach2016** which is hosted by the Unique Conferences Canada (UCC) with the support from other university-partners. This Canadian International Conference on the Advances in Education, Teaching and Technology held on July 16-17, 2016 at Ryerson University brought to the fore researchers, academicians, professionals and graduate students from all over the world, experts and practitioners in the field of teaching and education.

The conference was not only the biggest and most significant affair, but well-organized and meaningful one due to the collaborative efforts and meeting of minds of the people behind this endeavour. We want to extend our heartfelt thanks and appreciation to the members of the program committee led by Sir Prabhath Patabendi, the external evaluators and reviewers of the researches and session chairs for painstakingly offered their most precious time and talent in this activity. We, likewise, thank the Keynote Speakers, Prof. Michael Kyobe (University of Cape Town, South Africa) and Dr. Cristeta C. Dulos (Pangasinan State University, Philippines) for their brilliant ideas and insights they shared with us.

We are extremely happy to have a very spacious plenary and parallel session hall, which comfortable accommodated less than a hundred delegates coming from more than 20 countries all over the world.

The conference would not be possible without the excellent papers contributed by authors. It added to the fund of knowledge and enriched the learning experiences of the participants and made the conference as excellent as it has been. Likewise, the conference encouraged the productive interaction and academic exchange among the participants in the field of teaching and education.

The proceedings ended with a guided tour at the Center Island arranged by the convener himself with the conference staff. It was a worthwhile and refreshing day for all the participants to see a magnificent place composed of an island covered with green vegetation and recreational parks.

We feel honoured and privileged to serve the best recent researches and developments in the field of education. May this document serves as reference material to others especially those engaged in the field of education and stimulate further research endeavours in the future.

All the best that we can be

CRISTETA C. DULOS
Program Co-chair

IMPROVING STUDENTS' ACADEMIC ACHIEVEMENT AND ATTITUDE TOWARDS BASIC SCIENCE THROUGH PROJECT-BASED LEARNING (PBL)

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Abstract

The purpose of this study was to investigate whether project-based learning instruction would make a difference in students' academic achievement and attitude towards Basic Science in Ekiti State, Nigeria. This study adopted a quasi-experimental of pre-test, post-test research design on 360 JSS 2 students selected from nine secondary schools using multistage sampling technique. The two instruments used for this study are: Basic Science Achievement Test (BSAT) and Basic Science Attitudinal Scale (BSAS). The BSAT was a 25 multiple choice questions with 4 options drafted from the students' text materials while BSAS was a 4 likert type scale. The findings of the study revealed that there was an improvement in the academic achievement of the PBL group over the conventional group. The findings also showed that attitudes of project-based learning group were positive and differ significantly from the attitudes of conventional learning group in Basic Science. The study therefore suggested that science teachers should expose their students to science project-based learning that could bring about better understanding of the scientific concepts and improve ways of solving problems.

Keywords: project-based learning, academic achievement, attitude, junior secondary school students and basic science.

Introduction

No matter the strategies the teacher applied in the classroom, the end result is to lead students to learning goals. The channel to these goals may be difficult since students need to acquire new concepts and skills taught in the classroom. Even though, students may not have the knowledge of the new concepts, it is important for the teacher to present his/her lesson in such a way that students will understand the concepts using a pragmatic approach to the teaching of science. One of these approaches is the use of project-based learning (PBL).

Kilpatrick (1927), the advocates of PBL was of the notion that instruction based on PBL should include four components; purposing, planning, executing, and judging (Foshay, 1999). The roots of this notion dated back to John Dewey (1938-1999) who initially promoted the idea of 'learning by doing'. Dewey enumerated his beliefs regarding education that the teacher is not in the school to impose certain ideas or to form certain habits in the child, but is there as a member of the community to select the influences which shall affect the child and to assist him in properly responding to challenges. With strong roots in constructivist theories, PBL engages the students as active agents in a learning process characterized by recurrent cycles of analysis and synthesis, action and reflection. It is an authentic learning model or strategy in which students plan, implement, and evaluate projects that have real-world applications beyond the classroom (Westwood, 2008).

PBL has been considered as one of the most powerful strategies that can assist students' successes in the classroom. Numerous studies related to project instructional approach that utilize multifaceted projects as a central organizing strategy for project-based learning approach revealed that PBL has been found effective and helpful to individual students' achievement. For instance, Alacapinar (2008) and Kalayci (2008) affirmed that PBL helps the individual to develop his/her skills, attitude, sense of self-concept and studying skills in learning environment. Other literature suggested that PBL helps increasing the academic successes of students, helps students to understand conceptual knowledge as well as increasing their interest and curiosity and their eagerness to study (Keser, 2008).

As a proven evidence of the effects of PBL on achievement of students, Chen (2006), Syvester (2007) and Bas and Beyhan (2010) stressed that PBL was an alternative to other forms of learning strategies. Over the years, improvements have been recorded on the use of PBL on students. For example, a study by Penuel and Means (2000) on a five-year evaluation of the Challenge 2000 Multimedia Project in California's Sillicon Valley. Students were engaged on variety of projects and then presented their work at regional multimedia fair. Students in both project and comparison classrooms were asked to develop a brochure, targeted at school officials that would inform about the problems faced by homeless students. Students who have taken part in the multimedia project outperformed comparison students on all three measures associated with the brochure tasks: content mastery, sensitivity to the audience, and coherent design. In addition, results from the study demonstrated that gains in these skills were not achieved at the cost of growth in order areas. Students in the multimedia project made the same progress as did students in the comparison classes on standardized tests of the basic skills.

Recent research conducted by Mioduser and Betzer (2007) on the relative contribution of project-based learning to high-achievers' acquisition of technological knowledge and skills on 120 students using standard matriculation examination. The findings of the study revealed that the instructional process in which the experimental group students were involved contributed clearly to their learning of machine control knowledge and skills. Further analysis of the data used revealed a significant and positive change in the attitude between the pre and post-test achievement scores of the students in technology.

Considering students' attitudes towards science, George (2006) stressed that, one of the key factors in learning science is students' attitudes and the development of positive attitude and interest in science education and science-related careers. Attitude can be defined as a consistent tendency to react in a particular way, often positively or negatively toward any matter. Attitude possesses both cognitive and emotional components. In particular, many researchers have held the view that there is an important relationship between the attitudes of students, especially their attitudes to science. The study of Ali and Awan (2013) on the relationships of attitude towards science with the achievement in Physics, Chemistry, Biology and Mathematics, the study indicated that students' attitude towards science has a positive relationship with the science achievement among secondary school students.

Negative attitude towards science in schools may likely leads to a lack of basic knowledge of science. Therefore, improving students' science attitudes is an important step in developing students' interest in science and science related subjects. The research conducted by Thomson, Lokan, Lamb and Ainley (2001) showed that students who have positive attitude towards Mathematics and science obtained better results in Mathematics and science. The study also suggested that it is important for teachers to inculcate in the students positive attitude towards Mathematics and science if they want their students to have good achievements. This claim was supported by Magno (2003) in his study which showed that students who have positive attitude towards Physics achieved good grades in Physics.

Despite researches on PBL and its importance to students' achievement in schools, there are scanty works focusing on project-based learning in Basic Science teaching, most especially at the lower level of secondary school education where solid foundations are to be laid for students. Based on this, the researcher anticipates that adopting project-based learning in the teaching of Basic Science in the Junior Secondary Schools in Ekiti State, Nigeria will bring about better understanding of the scientific concepts and improve ways of solving problems in schools.

Purpose of the Study
The purpose of this study was to investigate whether project-based learning instruction would make a difference in students' academic achievement and attitude towards Basic Science among Junior Secondary School Two students in Ekiti State, Nigeria.

Research Hypotheses

The following research hypotheses were formulated to guide this study:

1: There is no significant difference between students' achievement levels of project-based learning group and conventional learning group in Basic Science

2: There is no significant difference between attitude of project-based learning group and attitudes of conventional learning group in Basic Science

Materials and Method

This study adopted a quasi-experimental of pre-test, post-test research design to examine the effect of the treatment on the subjects. The population for the study consisted of all the Junior Secondary School (JSS) two students in Ekiti State, Nigeria. The sample for the study consisted of 360 JSS two students (180 males and 180 females), randomly selected from nine secondary schools from the three senatorial districts of Ekiti State, Nigeria. The sample was selected using multistage sampling technique. In the first stage, simple random sampling technique was used to select three Local Government Areas from each of the three senatorial districts. In the second stage, a purposive sampling technique was used to select one school each from the nine Local Government Areas. The next stage was the selection of 40 students from each school sampled using simple random sampling technique. In all, 360 students was selected from nine schools and used for the study.

Two instruments were used for this study, these are: Basic Science Achievement Test (BSAT) and Basic Science Attitudinal Scale (BSAS). The BSAT was a 25 multiple choice questions with 4 options (a, b, c, and d) drafted from the students' text materials, the questions were used to measure students' attitudes towards Basic Science. The BSAS was a 4 Likert type scale (Strongly Agree, Agree, Disagree, and Strongly Disagree) adapted from the work of Moore and Foy (1997). In order to ensure validity of the instruments for the study, drafted copies of the instruments were given to the panel of judges in the of Science Education, two experts in the fields of Language Education and two experts in Tests, Measurement and Evaluation to adjudged the face and content validity of the items. The comments and suggestions made by these experts of judges were followed strictly to produce the final copies of the instruments. The reliability coefficients of the two instruments were ascertained through test re-test and Cronbach's Alpha methods. Test re-test method was used to ascertain the reliability of the BSAT and a reliability coefficient of 0.76 was obtained while the reliability of the BSAS was ascertained using Cronbach's Alpha analysis and a value of 0.81 was obtained. The values of 0.76 and 0.81 were considered high enough for the instruments to be used for this study.

The sample for the study was divided into experimental and the control groups. The PBL instructional technique was applied to the experimental group while the control group was exposed to conventional instructional technique. The duration of instruction was a five-week programme in all the nine schools selected for the study in the third term of 2014/2015 academic session. The Basic Science Achievement Test (BSAT) used for the study was pre-tested on the students before the treatment was applied. The essence of the pre-test was to ensure that the two groups are homogeneous in all respect. Growing maize plant with particular emphasis on improving yield using fertilizer was selected from *Spectrum Basic Science and Technology for Primary Schools (Middle Basic Education, Book 6) written by Adelekan,B. A et al*. Instructional package was designed for the teachers and students in the experimental group which contained series of activities to be demonstrated in and outside the classroom for the students based on the topics. The Basic Science teachers were trained on the rules of the experiment. The experimental group was asked to collect sample of maize, make ridges, planting on good soil, undergo thinning and supplying, observe the growth, applying fertilizer and weeding. After the third

week, students were asked to take records of all the observations. The control group were not engaged in this series of activities but were only taught the same topic as it was used to be in the normal classroom setting. The researcher and the two research assistants stood as facilitators during project/teaching processes by the teachers. The duration of the lessons was 45 minutes on each day of the experiment. At the end of the fifth week, a post test was conducted for the two groups using the same questions used as the pre-test. The project works of the students were marked and their scores recorded. The data collected were subjected to Analysis of Covariance (ANCOVA) and the two hypotheses formulated were tested at 0.05 Alpha level.

Results

Hypothesis 1

There is no significant difference between students' achievement levels of project-based learning group and conventional learning group in Basic Science

Table 1: ANCOVA showing students' achievement levels of project-based learning group and conventional learning group in Basic Science

Source	SS	df	MS	F-cal	F-table	P
Corrected model	2353.784	2	1176.892	435.162	3.04	0.000
Covariate (pretest)	2.673	1	2.673	0.988	3.89	0.321
Group	2326.610	1	2326.610	860.276	3.89	0.000
Error	965.504	357	2.704			
Corrected Total	3319.289	359				
Total	55544.000	360				

$P < 0.05$

Table 1 showed the achievement levels of project-based learning group and the conventional group in Basic Science. The table revealed that there was a significant difference in the students' achievement levels of project-based learning group and conventional learning group in Basic Science ($F = 860.276$, $P < 0.05$). The null hypothesis was rejected. This implies that there was a significant difference in the students' achievement levels of project-based learning group and conventional learning group in Basic Science.

Table 2: Multiple Classification Analysis (MCA) of students' achievement in Basic Science by treatment

Grand Mean = 12.04					
Variable + Category	N	Unadjusted Devn'	Eta^2	Adjusted for Independent + Covariate	Beta
Project-based	180	2.56		2.54	
			0.71		0.15
Conventional	180	-2.55		-2.53	
Multiple R				0.090	
Multiple R^2				0.008	

Table 2 showed the multiple classification analysis of students' achievement in Basic Science by treatment. The table revealed that students exposed to project-based method had higher adjusted mean

score of 14.58 than those taught using conventional method with an adjusted mean score of 9.51 (12.04 + (-2.53). The treatment accounted for 71% (Eta^2 = 0.71) of the observed variance in students' achievement in Basic Science. This implies that the use of project based instructional strategy would enhance students' achievement in Basic Science.

Hypothesis 2

There is no significant difference between the attitudes of project-based learning group and attitudes of conventional learning group in Basic Science.

Table 3: ANCOVA showing students' attitudes to project-based learning and conventional learning groups in Basic Science

Source	SS	Df	MS	F-cal	F-table	P
Corrected model	24936.350	2	12468.175	514.508	3.04	0.000
Covariate (pretest)	516.281	1	516.281	21.305	3.89	0.000
Group	24014.475	1	24014.475	990.975	3.89	0.000
Error	8651.247	357	24.233			
Corrected Total	33587.597	359				
Total	710021.000	360				

P < 0.05

Table 3 showed the students' attitude to project-based learning and conventional learning groups. The table revealed that there was a significant difference in the attitudes of project-based learning and conventional learning groups in Basic Science (F = 990.975, P < 0.05). The null hypothesis was rejected. Therefore, there was a significant difference in the attitudes of project-based and conventional learning groups in Basic Science.

Table 4: Multiple Classification Analysis (MCA) of students' attitudes towards Basic Science by treatment

Grand Mean = 12.04					
Variable + Category	N	Unadjusted Devn[1]	Eta^2	Adjusted for Independent + Covariate	Beta
Project-based	180	8.23	0.74	8.15	0.17
Conventional	180	-8.24		-8.16	
Multiple R				0.166	
Multiple R^2				0.027	

Table 4 showed the multiple classification analysis of students' attitude towards Basic Science by treatment. The table revealed that students taught using project-based instructional package had higher

adjusted attitudinal mean score of 51.54 (43.35 + 8.15) in Basic Science compared with those exposed to conventional method of teaching with an adjusted mean score of 35.19 (43.35 + (-8.16).

Discussion

The study showed that there was no significant difference in the pre-test scores of the students who were taught using PBL (experimental group) and the conventional (control group) in Basic Science. The finding indicated that the two groups of students were on the same level of achievement prior the treatment. The findings of the post-test showed that there was an improvement in the academic achievement of the PBL group over the conventional group. In other words, the experimental group who participated in the collection of maize sample, making ridges, planting on good soil, undergoes thinning and supplying, observing growth, applying fertilizer and weeding achieved significantly better in Basic Science than the conventional group who did not participate in the project. The differences between the PBL group and the conventional group can be attributed to the effectiveness of various activities performed by the students in the classroom during the project. The finding of the study corroborated the findings of Penuel and Means (2000) whose study demonstrated that students who took part in the multimedia project outperformed comparison students on all three measures associated with the brochure tasks: content mastery, sensitivity to the audience, and coherent design.

Further analysis of the study also revealed that there was a significant difference in the attitudes of project-based group and conventional learning group in Basic Science, that is, those students exposed to collection of maize sample, making ridges, planting on good soil, undergo thinning and supplying, observing growth, applying fertilizer and weeding showed more positive attitude towards Basic Science than their counterparts who are not exposed to collection of samples, planting, observing growth, applying fertilizer and weeding. This finding was in consonance with the findings of Thomson, Lokan, Lamb and Ainley (2001) whose study showed that students who have positive attitude towards Mathematics and science obtained better results in Mathematics and science subjects. In general, the findings of this study are also in agreements with the findings of Mioduser and Betzer (2007) whose study revealed that the instructional process in which the experimental groups were involved, contributed clearly to their learning of machine control knowledge and skills

Conclusion and Recommendation

Based on the findings of this study, it is sufficient to conclude that instruction based on PBL has proved to be effective in increasing students' achievement in Basic Science. It is therefore recommended that Basic Science teachers should expose their students to science project-based learning that could bring about better understanding of the scientific concepts and improve ways of solving problems.

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EFFICACY AND CHANGE: FROM TEACHER TO TEACHER EDUCATOR OF MATHEMATICS EDUCATION IN SPECIAL SCHOOLS IN AUSTRALIA

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Abstract

Recognising the intent of affirmative action to include the largest minority group in Australia, young people with intellectual disability in schooling, here, the role of special education teachers who teach mathematics and numeracy is considered. This article presents the empirical findings of a two-year action research/appreciative inquiry study of the impact of special education teachers' efficacy on student engagement in learning about mathematics. Evidence was drawn from pre- and post-survey data, workshop evaluations, and teachers' action research portfolio reflections. The impact of the professional learning programme on teachers who teach mathematics was documented in order to understand teacher efficacy and its benefits for students and the classroom environment.

This article presents a study of special education teachers who teach mathematics in special education schools in Queensland, Australia, with the aim of addressing affirmative action for students with intellectual disabilities and documenting the academic professional consequences of professional learning (PL) for special education teachers. More specifically, data is presented on the impact of PL on teachers' practice, their students' learning and the professional environment of their schools. This study draws on an action research/appreciative inquiry approach to address the question of the extent of the transition of knowledge from PL programmes to mathematics classrooms in order to better understand teacher efficacy and its impact. Teachers' PL is taken seriously, with the vision of a broad community of special education teachers and their students appreciating and enjoying access to learning about mathematics. By taking affirmative action into special education schools and mathematics classrooms, readers are asked to consider questions of education access for *all* children, including those who, by virtue of disability, race, and socioeconomic background, have been disproportionally exported to the margins of Australian education (Senate Standing Committee on Education and Employment, 2016).

Funding for this study, the YuMi Deadly Maths Programme, was derived from 12 participating schools through the State Schools Queensland *Great Results Guarantee*, a four-year funding initiative to improve student outcomes (Queensland Government, 2014). This programme passes on to schools funding provided by the Australian Government's *Students First Initiative* (Department of Education and Training, 2014).

Education as an Anti-poverty Strategy and Special Education Teachers

Education is an anti-poverty strategy to protect children and young people with a disability from disadvantage, but in Australia these people are the least likely to access an education that provides the best possible educational outcomes (Commonwealth of Australia, 2010). They typically have low levels of literacy and numeracy knowledge and skills, and as a consequence, a seriously compromised future as adults (SSCEE, 2016). Of concern is that this leads to reduced economic security, reinforces society's low expectations of people with disability and underlies a life entrenched in a cycle of poverty and disadvantage (Organisation for Economic Cooperation and Development, 2011). Australian society faces such an outcome because the rate of identification of intellectual disability in childhood is increasing.

There is a greater awareness of the need for access to education for children with intellectual disability. The Disability Standards for Education (2005) emphasises the continued obligations of schools and education providers to provide access for students with disability so that they can participate in learning without experiencing discrimination. Interconnected with this awareness is the need for suitably qualified teachers who are capable of providing learning opportunities that are informed by the Australian Curriculum Reporting and Assessment Authority (2013). For the purposes of this paper one area that is of current concern nationally and internationally is mathematics.

Empirical research evidence demonstrates that teachers, including special education teachers, lack sufficient mathematics and pedagogical content knowledge (Ball, Thames & Phelps 2008; Lannin et al. 2013). Currently in Australia, students with intellectual impairment and additional disabilities struggle to learn essential concepts and skills at both the primary and secondary levels of schooling. Although there is a strong commitment from teachers to support students with learning mathematics, their preparation and capacity to teach it is of concern (Browder, Spooner, Ahlgrim-Delzell, Harris & Wakeman 2008). Research indicates that many teachers have a poor understanding of teaching and learning for specific content areas, impacting on their efficacy in teaching mathematics and resulting in an overemphasis on procedural and low-level skills. Limited use is made of multimodal and multisensory instruction that more fully advances students' development of conceptual understanding of the use of mathematics ideas, equipment, and materials (Browder et al. 2008; Hunt, Valentine, Bryant, Pfannenstiel & Bryant 2016). The student–teacher interconnections within the field of mathematics education have created a significant loss of educational opportunities for students with disability (Browder et al. 2008). This concern provides the context for the understanding of teacher efficacy in this study.

Teachers' Professional Efficacy

In education settings change is often seen as difficult, uncomfortable and stressful, even when it is for the better (Tschannen-Moran, Woolfolk & Hoy, 1998). It can have a negative effect on teachers' personal teaching efficacy. Change challenges teachers' existing beliefs about the effectiveness of their teaching practice. It is a gradual and difficult process for them. To address any slumps in their confidence, teachers need encouragement, support and feedback as they learn about new approaches and then trial and implement them into their classrooms. This lower confidence may persist until such time that teachers see evidence of improvements in student learning.

Efficacy is identified as playing a key role in schooling and changing teachers' practice (Bandura, 1997; Gabriele et al. 2007; Tschannen-Moran, et al., 1998). Described in various ways, teacher efficacy is referred to as the motivation that teachers expend on the effort to implement a programme. It is about teachers' willingness to set challenging goals and the persistence to see them through (Gabriele et al 2007). From this perspective, teacher efficacy influences their determination and adoption of new ways of teaching by increasing their willingness to take risks and persist with difficulties and setbacks that come with the implementation process (Gabriele et al. 2007).

Reflection is a critical element in the development of teacher efficacy because it provides opportunities for teachers to reflect on and interpret their past performance. They can attribute their successes or failures and make judgements about their capabilities and deficits in teaching competence. Thus, teachers can 'weigh their self-perceptions of personal teaching competence in light of the assumed requirements of the anticipated teaching task' (Tschannen-Moran et al. 1998, p. 239). In doing so, the evidence of their past successes will strongly influence their expectations about themselves and the programme in the future. As they make sense of their teaching, take ownership and manage the implementation processes in their own ways, student efficacy also has the potential to be influenced positively (Bandura, 1997; Tschannen-Moran, et al., 1998). When teachers take an interest in, and notice, students' thinking during maths lessons, deep and sustained transformations occur in teachers' and students' efficacy. They are provided with efficacy information that sustains the motivation to keep teaching the kinds of lessons that are successful, increasing their efficacy as well as that of their students.

The PL Programme

The programme was designed for teachers (Preparatory to Year 10) who teach students underperforming in mathematics in special education schools in Queensland. Originally developed by a team of researchers at the Queensland University of Technology (Ewing, Sarra, Cooper & Matthews, 2014; Ewing, Cooper, Baturo, Matthews & Sun, 2010), it focused on schools with high numbers of Aboriginal and Torres Strait Islander students who were underperforming in mathematics. More recently the programme has been used in classrooms in Victoria and special schools in Queensland (See broadcast, Ewing 2015). The programme is underpinned by Payne and Rathmell's (1975) theory of mathematics

learning, and Bruner's (1960) three modes of representation (enactive, iconic and symbolic) are represented through a four-phased instructional cycle: reality, abstraction, mathematics and reflection (RAMR). Each phase builds on, and is connected to, the previous phase to stimulate and encourage conceptual understanding as well as automaticity and fluency.

1. R = Learning through awareness of local cultural and environmental knowledge and experiences about the idea; constructing and participating in kinaesthetic activities that introduce the idea and are relevant in terms of knowledge and experience.
2. A = Learning through the process of abstracting the idea from reality and representing it using the body-hands-mind; creating representations of it using the hands-body-mind—multisensory experiences, materials, language, and symbols.
3. M = Learning through enabling the appropriation of formal language and symbols for mathematical ideas; practising to become familiar with all aspects of the idea.
4. R = Learning through connecting the idea back to reality, enabling the validation and justification of one's own knowledge; using reflective strategies flexibility, generalising, reversing, and changing parameters.

The phases are interconnected and are not viewed as discrete and isolated throughout instruction. Teachers' and students' explicit connections from one phase to another are essential for learning concepts and skills. Without this awareness students are likely to feel as though they are memorising isolated procedures that have little connection to what they are learning.

There are several benefits for teachers who use this instructional cycle for teaching mathematics to students with disability. First, the RAMR instructional cycle provides multimodal forms of learning and opportunities for students to see the realities of mathematics in everyday life, orienting themselves to those ideas and the context from which they arise. These forms of learning include seeing, hearing, touching and muscle movement—visual, auditory, kinaesthetic and tactile learning aids memory and retrieval skills (Hunt, et al., 2016; Witzel, Riccomini, & Schneider, 2008). Second, students with disability and those who struggle because of other factors have multiple characteristics that affect their ability to learn mathematics. These characteristics include impulsivity, language deficits, hyperactivity, lack of prior knowledge, memory difficulties and motivation problems. They create the need for connecting the importance of content to everyday life to increase motivation (Browder, et al., 2008). Third, body movement and manipulation of materials in the reality and abstraction phases allows students to represent their reality using their hands, bodies and minds, materials, symbols and language in a range of ways to create meaning (Payne, et al., 1975). These phases allow students to recognise new experiences as having similarities to an already formed experience (White & Mitchelmore, 2002). Fourth, through this process, the construction of knowledge and meaning-making becomes a necessary condition for mathematics learning. Finally, the setting of problems back in reality enables students to validate, justify, and generalise their own knowledge so that they can extend on ideas.

To document the impact of the transition of knowledge from the PL programme to the mathematics classroom to better understand teachers' professional efficacy a research design was crafted to answer the following four questions:

5. Who are the special education teachers?
6. What is the impact of the PL programme on teachers' mathematical knowledge, experience and confidence?
7. What is the impact of the PL programme on teacher efficacy?
8. What is the impact of the PL programme on teacher efficacy and students' engagement in learning about mathematics in classrooms?

The research questions required that a quantitative analysis be undertaken to assess who the special education teachers were, their qualifications and their concerns. Another quantitative analysis was necessary to identify the teachers' efficacy pre- and post- the PL workshops. Further, qualitative analysis was undertaken in the form of a professional portfolio, thus encouraging teachers to document the impact of the PL programme on their practice, the students, and the classroom environment.

Method: **The Study and the Intention of Affirmative Action**

The study recognised the intent of affirmative action and necessitated a collective approach that had horizontal and vertical dimensions. The vertical dimension involved exchanges of views at different levels; e.g., between 12 schools and principals and 48 teachers. The project facilitated the engagement of two teachers to actively champion and promote the project across the 12 schools. In a sense they were the 'stewards of learning' who valued learning and were committed to it through their role (Bredeson & Johansson, 2000, p. 391). Through regular communicative tools such as email, telephone conferences and intensive face-to-face PL workshops, the project team and participants regularly collaborated across all aspects of the project. These strategies contributed to the 'population of values' (Davis & Dart, 2005), influencing participants and other teachers horizontally within schools. Given the substantial significance of the issue that this project aimed to address, it promoted ways for bringing people together as a collective in a group context to participate in organisational learning and change, knowledge sharing and making sense of impact. It advocated considerable dialogue about whether the proposed change was sustainable, who benefited and would other supporters of the project like it—all of these elements personified views about priority values.

An action research/appreciative inquiry (AI) study was used to monitor and evaluate the impact and interconnections with the change process for schools, principals, and teachers (Ford & Ashford, 2000; Hammond, 1996). AI has been identified as a reconfiguration of action research within organisational settings such as schools. It is described as a strategic planning model, participatory, and a system-wide approach that seeks to discover what works based on solutions that exist currently within organisations such as schools. Ethics approval to conduct this study was granted by the author's University Human Research Ethics Committee (Approval number 1300000001) and the Department of Education, Training and Employment, Queensland. Participant consent was sought in written form using university ethics approved participant information and consent forms.

Participating Schools, Principals, Teachers and Students

The 12 participating schools were from regional and metropolitan areas of Queensland. The participants in the project included 12 principals and 48 teachers. Principals were required to attend the first day of workshops in 2014 and 2015; this was to ensure that they were fully aware of the programme, its intentions, and purpose. They were tasked with creating a vibrant and successful learning community so that it became a collaborative venture among all staff in all participating schools (Bredeson, et al., 2000). As they were responsible for distributing the funding for the programme, building their capacity about the change processes involved, including the demands on teachers, was important to its successful implementation. The principals, in conjunction with individual schools' leadership teams, selected four highly motivated teachers from a range of school year levels to participate and lead the programme in their schools. Two project champions were nominated by the principals' leadership teams to guide the overarching implementation of the project.

Schools were provided with a one-day visit per year (two days across two years) to support teachers through lesson modelling, observation and critique of their practice. This process is in line with supporting teachers through change processes as they learn and trial new approaches. Participating schools were provided with supporting documents about the approach to teaching mathematics and resources on how to implement the project's approach. Participants were trained in action research and inquiry to monitor their progress with the implementation of the programme. They were workshopped on how to monitor their activities in their schools and gather data by way of a reflective portfolio that contained: (a) teaching plans (the RAMR cycle) and analysis and (b) student pre-/post-test results and analysis.

Data Collection Strategies

As part of their participation in the PL workshops, principals and teachers were asked to complete an evaluation and survey. Evaluative data was collected to identify the impact of the PL workshops. It allowed for developing an understanding of areas that needed strengthening and improvement during

future workshops. A 5-point Likert scale was administered to participants at the conclusion of each workshop day, with a select example of the results shown in Tables 4 and 5. The survey was administered in 2014 (n=36) and again in 2015 (n=7). It asked several questions related to teachers' practice. The portfolios aimed to identify the impact and increases of teacher efficacy as documented in their practice, student learning and the classroom environment.

Results
Impact of the PL Workshops on Teachers' Mathematical Knowledge, Experience, Confidence and Efficacy:

As part of the study, evaluative data pertaining to the PL programme was considered important to understanding the teachers' perceptions of the programme and their professional efficacy. An anonymous evaluation survey was provided to participants on each day so they could rate and comment on the programme workshops. Tables 1 and 2 provide a sample of responses from participants who attended the second (2014) and third (2015) round workshops.

Table 4. *Sample Responses From Participants Who Attended the Second Workshop (2014) (n=50)*

Q1. As a consequence of commencing the second round of PL how confident are you feeling with implementing the programme or elements of it?				
A whole school vision is clearer. Happy with where we have been, what we have implemented to date; however, very clear on our action plan for 2015.	Hearing how other schools are working and processing priority areas, possible focus areas to start into in 2015 has been beneficial to me and I feel confident that I can put a framework for 2015 in place.	I am feeling confident in being able to take ideas back to my school for other teachers. I am also excited to start more activities with my students.	We have already implemented elements into our school (numbers). Feeling confident to implement measurement after this round.	Quite confident. It's great to see the underpinnings clearly— i.e., the Rathmell Triangle, pre-foundational processes etc. flowing through.

The responses to Questions 1 from the Round 2 (2014) anonymous evaluation indicate that while there are challenges for teachers, these challenges appear to be affirmative. One reason for this is the use of the term 'confident' in the first series of responses. These responses are encouraging, because as the teachers learn about new approaches they appear to be transitioning them to the classroom and students. Of particular interest is the collective approach that is evident in the responses. The evidence suggests a vertical and horizontal dimension. The vertical dimension is reflected in the response, 'hearing how other schools are working…' The horizontal dimension is demonstrated in the responses such as 'whole school vision is clearer', 'feeling confident in being able to take ideas back to my school for other teachers' and 'we have already implemented elements into our school'. Although limited, each of these responses provide evidence that the programme is contributing to the population of values; that is, influencing other teachers in their respective schools (see Davis & Dart, 2005). Of further significance is that the teachers are demonstrating an increased willingness to take risks and persist with the difficulties that come with the implementation process. A critical element in the development of teacher efficacy is that it provides opportunities for teachers to reflect on, and interpret, their past performance (Tschannen-Moran, et al., 1998).The responses in Table 2 reflect and build on the responses in Table 1. It is not known if the responses are from the same participants as the evaluation was conducted anonymously.

Table 5. *Sample Responses From Participants Who Attended the Second Workshop (2015) (n=52)*

Q1. As a consequence of commencing the first round of PD in 2015 how confident are you feeling with implementing Geometry ideas into your teaching programme?				
I love geometry and I can see where I could implement some ideas.	Some good ideas. Good to look at and play with different equipment.	Haven't taught any geometry apart from recognising 2D and 3D shapes and properties of shapes.	Reasonably. The focus on vocabulary-building and our students' reality.	Yes, excited.

Of particular significance in the responses to the first question is the use of the terms, 'love', 'good ideas' and 'excited'. These terms are evaluative and reflect increasing efficacy. Interestingly, the response 'haven't taught any geometry apart from recognising 2D and 3D shapes and properties of shapes' suggests that this teacher's awareness of the strand of geometry has increased while alerting her/him to the narrowness of her/his focus stated in the response.

A Likert scale survey was administered in 2014 (n=36) and again in 2015 (n=7) (Table 3. It asked several questions related to teachers' practice. A value (1=strongly disagree to 5=strongly agree) was assigned to each response, allowing for reporting a single average for each response.

Results from the 2014 survey captured a range of item difficulties, including critical reflection in mathematics lessons and connecting realistic experiences to abstract language and symbolic language. There are reasons for why this might be the case, including that student characteristics such as impulsivity, language difficulties, hyperactivity, lack of prior knowledge, memory difficulties and motivation problems, may impact on their capacity to reflect on their learning. However, most of the items in the survey were found to be easier to endorse. For example, there was a degree of agreement with Statements 2, 3 and 8. Statement 2 (4.1) which focused on the link to reality suggests that the teachers recognise the importance of developing students' awareness of mathematics ideas in the local environment. Statement 3 (4.4) highlights the importance of providing verbal and non-verbal feedback to students. Feedback is critical to the teaching and learning process (Jeltova et al., 2011). It leads to students recognising their next steps and how to take them. It is underpinned by confidence that every student can improve and it involves every teacher and student reviewing and reflecting on the teaching and learning. These characteristics contrast with assessment that simply tests procedures.

Table 3. *Average Agreement With Each Statement Related to Teachers' Practice 2014 (1=strongly disagree, 5=strongly agree)*

Items about teachers' practice 2014	Used in 2014	Used in 2015
1. I display charts or reference materials that relate to mathematical concepts I am teaching in my room	3.8	3.8
2. I link my students' reality (prior knowledge) to the teaching of mathematics	4.1	4.2
3. I give verbal and non-verbal feedback to students with regard to their mathematics learning	4.4	4.7
4. I ensure that goals for maths are set in my classroom and that the strategies for improvement are evident and understood within the process	3.7	4.4
5. I connect the students' reality experiences to abstract the language, represent that reality and being using symbolic language	3	3.1
6. I give my students opportunities to use their whole body, hands and minds/images	3.6	4.7
7. I use pre-/post-testing in my classroom to plan for future teaching	3.4	4.4
8. I track to see how students are doing within a lesson by 'checking in'	4	4.4
9. The maths concepts that students learn are situated in reality and guided by the abstraction process	3.6	4.5
10. I include opportunities for students to critically reflect on their learning of maths	2.4	3.1
11. In my maths lessons I guide students with critically reflecting on their maths learning	3	3
12. I am confident with teaching maths in my classroom	3.4	4.1

While 48 teachers and 12 principals participated in the programme, the overall response rate in 2015 was 12% and therefore renders this survey as not comparable to that from 2014. Nonetheless, of the participating teachers who completed the survey the results captured strong indications of the participants embracing the change process and trialling and implementing the programme into their classrooms (Gabriele, et al., 2007). Efficacy plays a key role in changing teachers' practice and these results indicate that the teachers were willing to be challenged and persist to see through the difficulties that came with the implementation process. The results also indicate that teachers have worked to transition ideas from the PL programme to the classroom (see Clemans, Berry, & Loughran, 2010). It suggests that the teachers have reconnected with their professional expertise as this process has facilitated their making connections between their teaching, student learning and the classroom environment.

The adoption of reflective portfolios as a research strategy in the project aimed to engage teachers in their own learning as well as that of students. Through this process, teachers could trial new techniques

as well as create new PL collaborations. However, the teachers needed to believe that they could perform instructionally related tasks that were likely to bring about increased student learning. The following sections describe this aspect in more detail.

Impact of the PL Workshops on Teacher Efficacy and Students' Engagement in Learning

Of the total number of participating teachers in 2014 (N=48), 48 portfolios (100%) from 12 schools were received in Round 1 in 2014. This represents a substantial result for the project, and demonstrates the high level of engagement of the participants. In 2015, 25 portfolios were received from the 12 schools.

The data from the portfolios indicate that the experience of moving the PL to the schools, classrooms and students allowed the teachers to reconnect with their professional expertise. Clemans et al. (2010) reinforces this aspect by stating that this process facilitates the teachers making connections between their teaching, student learning in the classroom and the staffroom. It encourages teachers to build on their professional strengths and the practices that they use to engage learners and share these with their colleagues. Excerpts from the portfolios express these connections:

> *Staff and students found this topic fun and exciting. Also found that since students enjoyed it so much, they seemed to understand concepts quickly. Some positional activities: Students chose a toy and I asked them to place it in a drawer, under the chair, on the shelf, beside the sink etc. Introduced the idea of stepping over the chair and then under the table. The students then created their own obstacle course around the classroom. It was amazing to watch the students understand and self-direct their learning. (Portfolio, teacher, Karolina)*

As Karolina made the connections between her teaching, other staff and the students' learning, she will be more readily able to 'see' in the future how by increasing her efficacy she will be able to weigh her perceptions of her teaching and personal competence. Past successes will strongly influence her expectations of herself, her staff and her students as they learn about mathematics.

> *Able to expose students to broader concepts/big ideas through … pedagogy. Still developing further means for pre-/post- assessment that is accessible for all students. Pedagogy allows for engagement of students at various levels throughout lessons. Students require further intervention to make links between reality/abstraction phase of learning and the mathematics. Continued work (at a school level) on frameworks/templates for recording planning. Some students may have not shown vast development by moving through content; however, their engagement and understanding of concepts appears to have been consolidated. Students may at times make links to previous learning experiences through other activities. (Portfolio, teacher, Katherine)*

Past success and experience allows for making sense of teaching. Katherine shows that she is taking ownership of the implementation process in her own way. In doing so, the students' efficacy is shown to be affirmatively affected. When teachers like Katherine take an interest in, and notice, students' thinking and learning during mathematics lessons, transformations in teaching and learning occur.

> *Engagement levels: Students enjoyed the hands-on kinaesthetic activities to explore key concepts. Students responded well to the use of stories to help define key terminology. Some of our students with autism found group work on the floor away from their desks a little difficult so visual symbols of tasks, 'first this, then this' cards, and reward systems were put in place. Confidence levels: Students were more willing to try new activities and tasks as the cycle went on. All students had a go and enjoyed being praised and rewarded for their attempts. (Portfolio, teacher, Kalila)*

Hence, the teaching and learning environment is also transformed. When students are engaged in multisensory learning to investigate and learn about mathematics, as evidenced in Kalila's response, through their development of a conceptual understanding of mathematical ideas and how to use them they are provided with efficacy information. This information is what sustains the motivation to keep teaching the kinds of lessons that are successful for students, increasing their efficacy as well.

The importance of teachers transitioning the knowledge and experience gained from their PL to their school, the staff and students was integral to the ways in which she would implement the programme. They are learning about their roles as teacher educators, while as the same time learning about the significance of that role and the purpose of their work. The PL programme aimed to bring about affirmative action by the teachers who taught mathematics in special schools in Queensland. More specifically, it aimed to develop teachers' efficacy and understand the impact that this would have on

their transition role of becoming teacher educators of the programme to schools, other staff, students and the learning environment of the classroom. These aims are worthy of examining in light of the data portrayed above.

Lessons from the PL Programme

An evaluation of how the PL programme ably supported the teachers' and principals' learning needs to be considered given the core professional curriculum and pedagogy that were presented for these educators and how the PL programme attempted to address these issues. Here, several significant issues that the teachers and principals confronted and the capacity of the PL programme to respond appropriately are addressed below.

Starkly apparent in the goals presented early in the paper was evidence that these teachers had very specific, but complex, goals that they wanted to achieve in the PL programme. Most of these goals posed difficulties for the teachers. In doing so, they brought to light their vulnerabilities within a complex teaching and organisational context that required them to be responsive to the leadership and culture of their schools, the mathematics learning of their students, and their collective professional relationships with their colleagues; not to mention the pedagogy of professional and mathematics learning. They were expected to develop and evolve from classroom teachers to teacher educators who could speak with authority about mathematics education for special schools—a challenging and complex task.

While such collaboration and conversation with peers was critical to the success of the programme in the participating schools, the study had not formally anticipated the importance and significance of teachers evolving to become teacher educators. This evolution is complex, with teachers likely to experience a sense of fear and feel that they would be seen as imposters by their colleagues: self-doubt (Clemans et al 2010). The development of the PL teams (teacher educators) within each of the schools provided them with an intimate space in which to share their trials, frustrations, vulnerabilities and insights. In doing so, the teams offered the potential to more explicitly and affirmatively take up issues related to the implementation of the programme and of becoming teacher educators. These strategies worked to build their efficacy.

The PL programme and school principals asked participating teachers to take up the role of teacher educators. Explicitly this role required learning through collaboration with teachers becoming knowledgeable and knowing people who could educate their colleagues in the context of PL. These ideas are congruent with the appreciative inquiry/action research methodology that was used in the study. This approach enabled teachers to identify themselves as knowable and able to develop and articulate their professional knowledge with leading learning with their school colleagues. While the writing of the portfolios was an individual endeavour, this approach fostered a powerful environment for PL where affirmative action could be documented, analysed and reported.

The aspects of the programme discussed above, together with its focus on students with intellectual disability and mathematics education, emerged as relevant to supporting the development of the skills of teachers who participated in it. However, there does need to be explicit recognition of the ways in which teachers are asked to become involved in programmes such as the one in this study and how they are to become teacher educators—thus building their efficacy. These two roles are different and entail varying skill sets and knowledge. The recognition of the vulnerability issues and difficulties that they encountered as they moved between these two roles in the programme holds implications for other programmes that aim to encourage and shift teachers into new roles and spaces as leaders. Without this recognition inefficacy is likely. There is a tendency to assume that teachers can shift roles and that this process is unproblematic (Clemans et al 2010). Given that teachers' foundations are framed within classrooms, such spaces might be the reference point for beginning in the role of teacher educator in the programme, where they can rehearse the transition of the knowledge and learning that they subsequently experience. Finally, this study reminds us that while engaging and encouraging teachers to learn about mathematics and how to teach it in engaging ways to students with intellectual disability, we cannot overlook the importance and significance of the 'who I am' and how this evolves over the duration of PL and beyond.

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A COLLABORATIVE E-LEARNING SYSTEM WITH ADAPTIVE GUIDANCE TO IMPROVE MATH PERFORMANCE OF STUDENTS WITH DISABILITIES

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Abstract

Online collaborative learning has been recognized as an effective learning method. However, since students with disabilities learn differently from normally achieving students, adaptive guidance is required in online collaborative learning for students with disabilities. This paper presents an online collaborative learning environment with adaptive guidance to improve the math performance of students with disabilities.

The learning process in this online learning environment includes steps of math problem solving, which were conducted by a heterogeneous learning team with two or more students with disabilities. The adaptive learning guidance method includes dynamic learning path planning and adaptive learning material selection according to the learning status of the team members, math error type identification and coaching, and remedial teaching, which were provided to students with disabilities based on their disability types, thinking styles, learning styles and math abilities.

A series of experiments were conducted in two months to evaluate the effectiveness of the proposed adaptive guidance method in an online collaborative environment. 40 junior high school students with disabilities from seven to nine grades participated in the experiments. The mathematical curriculum of seventh grade in first semester used for the research included integers, fractions and algebra arithmetic. Experimental results indicated that students who were supported by the adaptive learning guidance exhibited improved learning performance, and showed more confidence in collaboration with others.

Keywords: *Adaptive learning, Students with disabilities, Collaborative learning, E-learning, math learning*

Introduction

Due to the increasing number of students with disabilities, improving their learning performance has become an important education issue (World Health Organization, 2011). Students with disabilities may differ in regard to the severity of their disabilities and personal abilities, therefore it is necessary to provide adaptive learning methods and materials in order to meet their unique needs (Haring and Breen, 1992).

About 26% of students with disabilities have to receive remedial math instruction (Fuchs and Fuchs, 2001, Mazzocco and Myers, 2003). Research proved that suitable strategies would be a great help for improving students' math performance (Miller and Mercer, 1997, Montague, 1992).

Scholars agreed that collaborative learning that blends normal students with students with disabilities is an effective learning strategy, which benefits both normal students and students with disabilities (Jenkins et al., 2003). In addition, it is believed that computer-supported collaborative learning (CSCL) can effectively enhance students' math achievements (Jackson et al., 2013, Lazakidou and Retalis, 2010).

To summarize, online collaborative learning with adaptive learning strategies and learning materials could help students with disabilities learn math more effectively. Therefore, in this study, an "adaptive Learning guidance method" was designed and implemented in an online collaborative learning environment to help improve the math learning performance of students with disabilities. This system applied problem-oriented learning method for collaborative learning, in which a series of adaptive learning guidance were provided based on the special needs and personal characteristics of the students. Finally, experiments were conducted to evaluate the effectiveness of the method on math performance of students with disabilities.

Related Work

1. Math problem solving by students with disabilities

    In order to improve students with disabilities' math learning performance, this study applied Polya (2014) math problem solving process, which is the first systematic process for solving math problems. This math problem solving process includes four steps of understanding the problem, devising a plan, carrying out the plan, and looking back, which let students know what to do next when they are solving math problems.

2. Collaborative learning for students with disabilities

    Among all collaborative learning strategies, studies (Dugan et al., 1995, Mevarech, 1993, Salend and Washin, 1988) showed that student teams-achievement divisions (STAD) strategy is an effective math learning strategy for students with disabilities, therefore our proposed collaborative learning method was designed based on STAD, which includes teaching, team studying, testing and reward.

3. Adaptive learning guidance

    Brusilovsky (1998) presented an adaptive e-learning system providing personalized applications and services, and proved it was more beneficial than traditional e-teaching. There are numerous ways to provide learning guidance in an e-learning environment, including planning a learning path and analyzing the course structure, all of which are helpful for learners (Macías and Castells, 2001). In this study, the proposed adaptive learning guidance was defined as giving step-by-step instructions to students in order to assist them with making gradual progress and reaching their learning goals.

Adaptive Guidance for Collaborative e-Learning System

A collaborative e-learning system with adaptive guidance was designed as shown in Figure 1. The functions of this system are explained below.
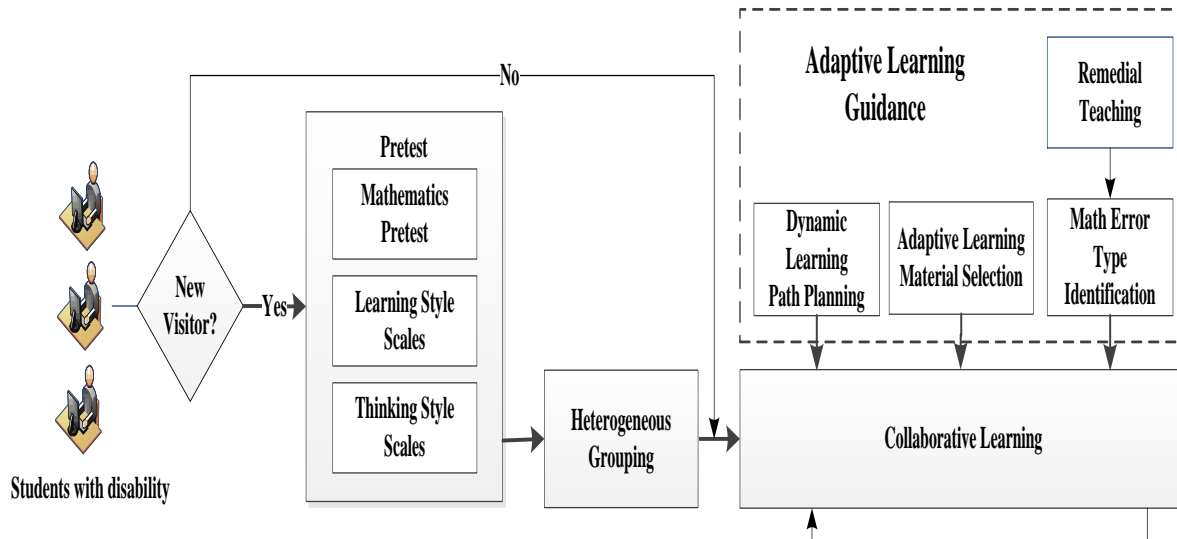
Figure1Learning process in the collaborative e-learning system with adaptive guidance

1. Pre-testing:

    Pre-testing is used to assess the personal characteristics of the students and their math knowledge, which are then used for adaptive learning guidance. In this part, mathematics pretest (for evaluating student's math problem-solving ability), learning style, and thinking style are assessed using web-based exams and questionnaires.

2. Heterogeneous grouping:

    Since genetic algorithm is effective to solve heterogeneous grouping problems (Chen et al., 2012, Moreno et al., 2012), a heterogeneous grouping method were developed using genetic algorithm to form heterogeneous learning teams based on students' personal characteristics and math knowledge.

3. Collaborative Learning:

    Collaborative learning in this system is based on problem-based learning method and STAD strategy, in which students learn the math concepts in the class before using the e-learning system, and they use the system to discuss and solve the math problems with other group members. During the discussion, Polya's math solving process will be presented by the system in order to help students have a smooth discussion. Each math problem is itself a small test, after answering the problem, the learning team will obtain feedbacks based on the answers. The collaborative learning process repeats till the end of the learning session. At the end of learning process, a group score and individual scores, as well as appropriate rewards are provided by system.

4. Adaptive Learning Guidance

    Adaptive learning guidance is carried out along with collaborative learning in terms of the following steps.

    (1) Dynamic Learning Path Planning: Before each learning session, the system plans an adaptive learning path based on each team member's answers in pre-test, in order to reduce learning difficulty and make students feel less frustrated.

    (2) Adaptive Learning Material Selection: The system presents teaching materials that suit most of the team members based on their math abilities and learning styles. The system also provides proper hints and guidance for discussions based on the thinking style and math ability of the majority of the team members.

(3) Math Error Identification and Coaching: After each student submits his/her answer, if the answer is wrong, the system provides suitable remedial learning strategies for individualized remedial learning based on student's math errors type.

(4) Remedial Teaching: after the error identification and coaching, if most of the group members' answers are wrong, the system will present a similar math question to reexamine students' knowledge of math concepts.

Method

1. Participants

40 participants from junior high school were allocated to ten learning teams. Each team is formed of one gifted and talented student, two students with learning disabilities (LD), one student with intellectual disability or mental retardation (MR), and one student with attention deficit hyperactivity disorder (ADHD). The gifted and talented student was selected as the group leader. Five of the ten learning teams were randomly selected into an experimental group for adaptive collaborative e-Learning guidance, while the others were in a control group for blended class small group instruction.

2. Procedure

The research procedure includes four stages as follows:

(1) Pre-test: all the participants were required to take a math test prior to the experiment for the purpose of evaluating the participants' math ability and math problem-solving skill. Students in the experimental group took the tests in our collaborative e-learning system, while students in the control group took paper and pencil tests.

(2) Experiment: the experiment took about 2 months, and all participants participated in two sessions per week. Each session lasted for 45 minutes. The students in the experimental group used our collaborative e-learning system for learning, while students in the control group adopted the traditional face-to-face collaborative learning in a blended classroom.

(3) Post-test: one week after the experiment, the participants in both groups were given a math test to determine their learning performances.

(4) Date collection, processing, and analysis: a one-way independent AVOVA and T-test were used to determine the effectiveness of two teaching methods on math learning performance.

Results and Discussion

Before the experiment, there was no significant difference in math problem solving (F =.61; p >.05) between students in experimental group and students in control group. However, after the experiment, we found that even if the average score of students in the experimental group was higher than the average score of students in the control group, there exists no significant difference (F =3.565; p= .067) in between the two groups. We analyzed further detail as to determine whether students with different score levels obtained different outcomes in the post-test.

The descriptive statistics for all students' math scores is as shown in Table 1. In terms of the test participants' scores, the participants with middle-score in the experimental group showed p= .003<.001. The results indicated that after the experiment, participants' middle-score in the experimental group apparently outperformed those in the control group. However, there exists no significant difference in between participants with high-score and participants with low-score. Since the students with middle-score were the majority in classes, it can be concluded that adaptive collaborative e-Learning guidance is

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conducive to enhance most disabled junior high school students' math learning performance.

Table 1 The descriptive statistics for the math scores of students in the two groups

Group	score level	Pre-test score Mean(SD)	Post-test score Mean(SD)	Number
Experimental group	High-score	61.00(8.94)	82.00(2.74)	5
	Middle-score	42.50(20.58)	54.50(14.99)	10
	Low-score	12.00(9.08)	17.00(7.58)	5
Control group	High-score	66.25(17.02)	67.50(9.57)	4
	Middle-score	41.82(8.45)	35.91(4.91)	11
	Low-score	33.00(12.55)	22.00(10.36)	5

Some possible explanations for the lack of a significant difference between the experimental group and control group for participants with high-score and participants with low-score may include:

1. Before the experiment, the students with high-score have had good math knowledge, so no matter which teaching methods were provided, they can learn well.
2. The learning performance of students with low-score appeared to be behind by one or two years, so their math ability might not be able to improve in the two-month experimental learning.

Conclusions

In this study, 40 junior high school students with disabilities were grouped into eight heterogeneous learning teams which were further divided into an experimental group and a control group to carry out the experiments according to a quasi-experimental design. An "collaborative e-learning system with adaptive guidance" was implemented in four experimental teams of the experimental group, and "blended class small group instruction" was implemented in four teams of the control group. According to the results of the experiments, the following conclusions were drawn:

1. The performances of the experimental group were better than those of the control group even there was no statistical significance.
2. The performances of the participants with middle-score in the experimental group were better than those in the control group with statistical significance.
3. Comparing the performances of the participants with high-score and the participants with low-score, teaching methods made no significant difference.
4. It was found that, in most cases, the experimental group apparently outperformed the control group. However, more learning subjects and attributes of disabilities should be evaluated in further study to verify the above-mentioned findings.

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PRACTICE AND REFACTORING LOG: A REFLECTION BASED LEARNING STRATEGY TO IMPROVE THE FLUENCY OF COMPUTING STUDENTS IN WRITING COMPUTER PROGRAMS

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Abstract

The relationship between reflection and learning is evident. Reflection plays a significant role in learning by encouraging insight and complex learning. However, most students consider their work experiences at school as isolated and unrelated events. This work aims to investigate how to improve the students' fluency in writing computer programs through reflection. A new deliverable, the Practice and Refactoring Log ("PAR Log"), is requested for each assignment in order to engage students in the process of making meaning from their experiences when completing their assignments. The PAR Log shows and justifies all changes through the assignment development cycle. Two student groups were required to develop and submit the PAR Log with all assignments, for credit. The performance of each group was compared to a similar group taught the same course by the same professor using the same assignments but without requesting the PAR Log. This paper presents the background, methodology, results, analysis and conclusion of this investigation.

Introduction

This study was motivated by our collective experiences in the classroom and the observation that many computer science students were not able to explain their work. It is commonly accepted in mathematics that showing your work is equally as important as arriving at the correct solution, yet in computer science we grade solely on the final version (and some planning or modelling). In addition, we noticed our students tend to think of their assignments as isolated events. Based on our understanding of the value of reflection in promoting insight and complex learning, we wondered, if we required our students to show their work by providing a PAR Log, would the students' coding fluency increase?

Methodology

In the **winter term of 2016**, we chose two programming classes to study. The first is Java programming, level 1 and the second is C programming, level 4. The students in these classes were asked to submit a PAR Log with every assignment. The PAR Log was **worth 15%** of the overall assignment grade. The PAR Log was meant to show each revision a student undertook to approach their final program as well as any outside practice such as attending a tutoring session, watching an online video or attending office hours. The PAR Log was presented to the students as follows: The "refactoring" portion of the PAR Log satisfied the "show your work" requirement and the "practice" portion of the PAR Log supported the goals of reflection and connection.

Results

Both classes were compared with a **control group** of students taught the same course by the same instructor with the same assignments, in a previous semester. The students in the C programming course showed no statistically significant improvement in grades over the term yet the students in the Java programming course did show a **significant improvement in grades** (see Figures 1, 2, and 3). The two

groups showed a significant **improvement in the professors' rating of student comprehension** and ability to explain their work, likely brought on by the additional reflection and/or practice involved.

Figure 1: Median grades for assignments, quizzes, and midterm exam calculated to compare the performance of two Java programming classes. The first class was offered in the Fall 2015 term when the PAR Log was not required. The second was offered in the Winter 2016 term when the PAR Log was required.
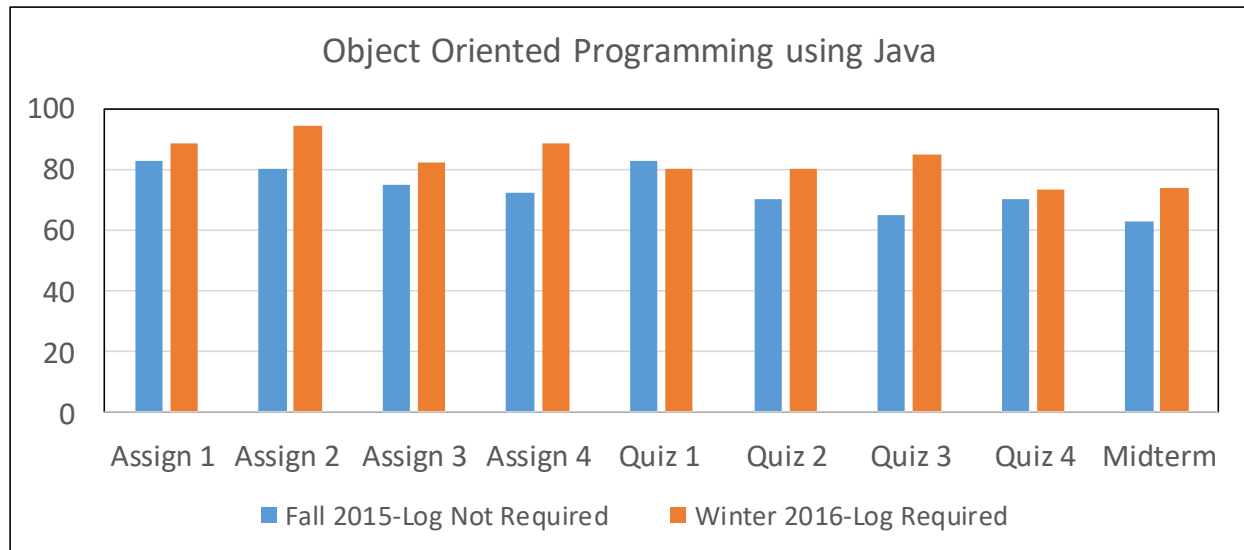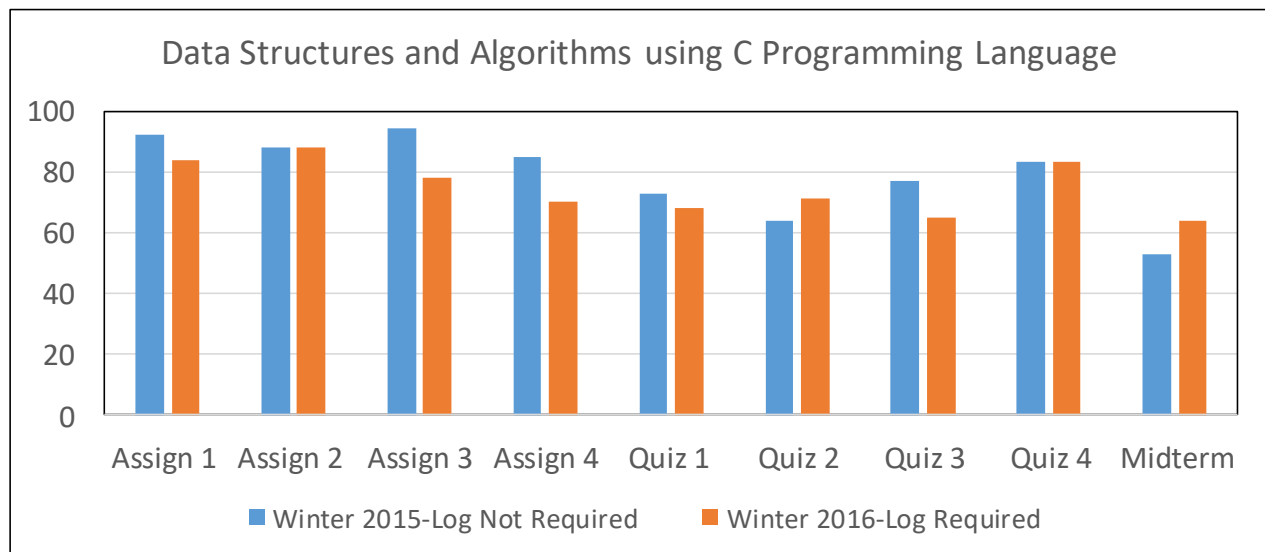

Figure 2: Median grades for assignments, quizzes, and midterm exam calculated to compare the performance of two C programming classes. The first class was offered in the Winter 2015 term when the

PAR Log was not required. The second was offered in the Winter 2016 term when the PAR Log was required.

Discussion

The Java class's grades on assignments, quizzes and the midterm exam significantly increased by 9.4% (using median values) compared to the grades of the Java group that was not required to submit the PAR Log (see Figures 1 and 3). This was probably an effect of the reflection practiced by the students to develop the PAR Log properly, as reflection encourages insight and complex learning (Costa, A. & Kallick, B., 2008), (Kolb, D., 1984).
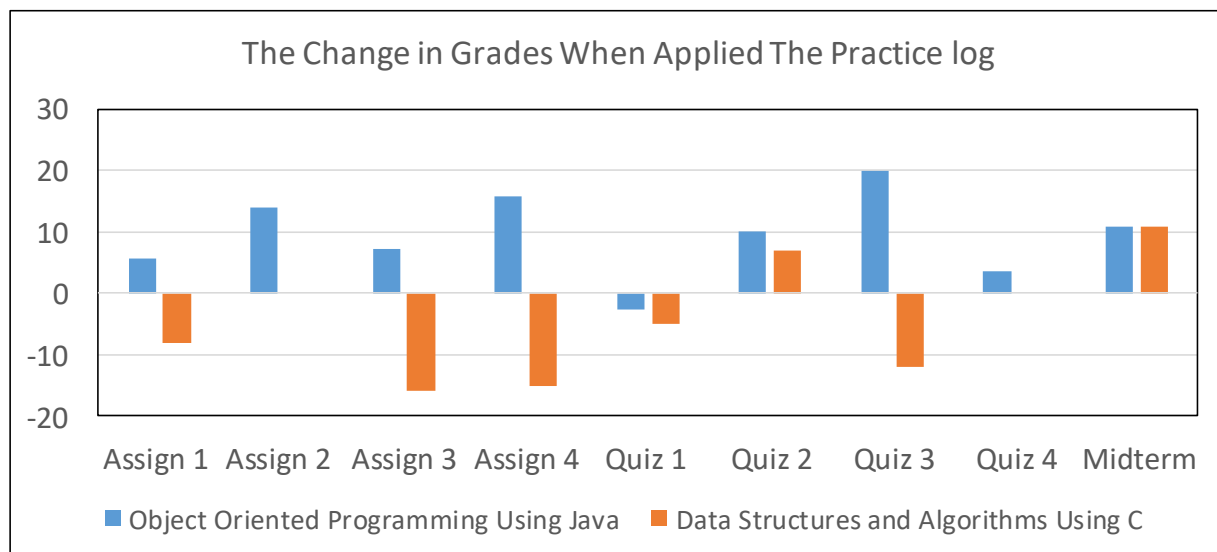

Figure 3: The difference between the grades' medians before and after using the PAR Log for engaging students in reflection in the Java programming and the C programming classes.

On the other side, the change in the C class's grades of assignments, quizzes and midterm exam was not significant (see Figures 2 and 3) compared to the grades of the C class that was not required to submit the PAR Log. This may be explained by the variation in the course levels, as the C course is taught to the fourth term students but the Java course is taught to the first term students. This may indicate that the learning habits of the fourth term students are not as easy to change compared to those of the first term students. The first term students expect and accept changes in learning methods because it is their first experience in post-secondary education. Reflection skill has proven to be relatively challenging to develop (Gustafson, K. and Bennett, W. ,1999).

The improvement in the reasoning ability of the Java students is demonstrated by the increased grades in the quizzes and the midterm exam. The quizzes and midterm exam grades of the Java class significantly increased by 8.4% on average (again using medians) compared to the grades of the corresponding class that was not required to submit the PAR Log (see Figures 1and 3). This improvement could be attributed to the PAR Log since it forces practice in reasoning which is the backbone of the quizzes and the midterm exam.

The C class's median of the midterm exam grades increased by 11% compared to the grades of the corresponding class that was not required to submit the PAR Log (see Figures 2 and 3). This was probably a late response to the consecutive teaching moments that encouraged students to change their learning habits and practice reflection. The relative improvement in the grades of assignment 4 supports this late response explanation too because assignment 4 is the most challenging assignment in the course.

Conclusions

This work investigated a new strategy that improves a student's fluency in writing computer programs through reflection. The strategy employed was to request a deliverable, the Practice and Refactoring Log, to be developed and submitted with each assignment. The PAR Log shows and justifies all changes throughout the assignment development cycle. Developing this PAR Log engages students in the process of making meaning from their experiences when completing their assignments. Two student groups were asked to develop and submit the PAR Log with all assignments, for credit. The first group was an introductory Java course and the second group was an advanced C programming course. The performance of each group has been compared to a similar group taught the same course by the same professors but without requesting the PAR Log. The results show an improvement in the students' ability to describe and justify programming design selections across both groups. The grades of the assignments and quizzes of the Java group are significantly improved but the grades of the C programming group are not improved. Thus we conclude that using the PAR Log in the first semester is more effective at increasing programming fluency because new students are more receptive to building and changing their learning habits at the beginning of their post-secondary program.

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AN APPRAISAL FOR APT TEACHING AND LEARNING METHODS FOR EFFECTIVE STUDENT LEARNING IN ENGINEERING EDUCATION

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Abstract

Teaching and learning methods in engineering education have evolved significantly over the past few decades. Furthermore, it is gradually shifting from traditional methods of education to modern digital modes, involving Information and Communication Technology (ICT). However, the question still remains regarding what balance should exist in using the two methods of education; the challenge being ensued from the nature of the subjects and content of the syllabi. Therefore, using a case study of a University of Technology in South Africa, the paper examined the relevancy of the current teaching methods and their impact on student learning in engineering education. A survey research method and qualitative discussion with students and peers were used to conduct the study. The survey was conducted among the Bachelor of Technology students over three consecutive semesters using convenient sampling (n = 320). Findings suggest that there is a definite acceptance of digital methods and ICT in teaching and learning among the students. Student engagement in class room activities using digital methods, such as power point/web linked presentation, and videos, is appreciably lower. However, student learning is significantly higher through the use of the mixed method approach (appropriate mix of traditional and digital), particularly in modules involving mathematical or design aspects. The study concluded that there is a need for using the mixed method approach in suitable proportions with higher involvement of teachers and students in the class room for effective teaching and learning in engineering education.
Keywords: Teaching and learning; Traditional methods; Digital technology

Introduction

As the teaching and learning methods evolve with incorporation of new ideas, innovations and technologies, arguments and debates emerge regarding the apt methods of teaching and learning. The higher education community at large is debating over the issue for a long time and is trying to unearth appropriate method(s) that could be effective and enhance student learning (Braskamp, and Ory, 1994; Braskamp, and Ory, 2000; Collins and Robert, 2004; Dash, Patro, Behera, 2013; Khurshid and Ansari, 2012). In this process different methods have been put to practice. Despite the debates and efforts to put different methods to practice, no unanimity on the effective learning method(s) has been achieved. For some scholars, it could be a method or process that produces beneficial and purposeful student learning through the use of appropriate procedures (Centra, 1993). Some other scholars argue that it is the creation of situations in which appropriate learning occurs (Braskamp, and Ory, 1994; Braskamp, and Ory, 2000; Felder, and Brent, 2004). Similarly, according to McCarthy (1992) an appropriate teaching and learning method is that which presents factual material in a direct and logical manner, inspires the students from experiences, stimulates thinking to open discussion, and develops creativity among the students and students learn better. This supposition is supported by several other scholars (Kochhar. 2000, p.345; Sullivan & McIntosh 1996). Consequently to achieve effective student learning a large number of ideas and innovations have been incorporated in the teaching and learning process particularly over the last two decades. The ideas and innovations which are largely influencing the teaching and learning process include modulating the behavior and attributes of teachers/ presenters, creation of suitable environment, moving to student centric learning, deciding the size and composition of class, evolving various teaching methods, incorporation of digital technology and e-learning system and so on (Bradford and Wyatt, 2010; Caywood and Duckett, 2003; Khurshid & Ansari, 2012; Rowe, 2006; Teo & Wong, 2000). However,

despite the efforts central point remains unresolved as to how effective teaching and learning, can be achieved. The scenario becomes more complex in engineering education because of its nature and type of content it deals with.

Apparently it is evidenced that teaching and learning methods in engineering education have also evolved significantly over the past few decades. Conventional method of teaching, particularly class room teaching, which essentially constitutes a typical classroom environment with a presentation from the course teacher with direct contact with the students and use of a typical medium of board and marker (chalk) has its own merits. In such method the teachers and students are both actively involved, and the method is found to be particularly successful in the subjects that need analysis, design and mathematical expressions and modeling that require teacher's explicit explanation (Khurshid & Ansari, 2012). However, in recent years the teaching and learning is gradually shifting from these traditional methods of education to modern digital modes, involving Information and Communication Technology (ICT) and digital tools and techniques (Bradford and Wyatt, 2010; Caywood and Duckett, 2003). Scholars have argued that digital contents act as catalysts for education and learning. It assists in enhancing traditional educational content; for example, incorporation of multiple media facilitates self-learning and continuous education by providing easy access (anytime and anywhere), supports various learning styles (self-paced, collaborative, team-oriented, etc.), and enriches the static content with narratives, game-playing, hands-on activities, and so on (Anderson, & Cartafalsa, 2010; Bradford and Wyatt 2010; digitallearningday.org; Subramanya, Jolla, 2012; VanderArk & Schneider, 2016). However, the effectiveness of these methods depends on the context, mode of presentation and nature of content. The effectiveness of the traditional method largely depends on the communication attributes of the presenter/ teacher such as voice, gesture, movement, facial expression, and eye contact, which can either detract or complement the content (Adunola, 2011; Ganyaupfu, 2013).

Although, both conventional and digital methods have advantages and limitations, the effectiveness of the both the methods have not been conclusively established. So there is a necessity to appraise the aptness of a method(s) towards effective student learning. However, instead most of the researches are found to be tended to focus upon student satisfaction than upon performance, unaware of that student satisfaction and performance are two different aspects and are linked to teaching/learning relationships or interactivity (Anderson & Cartafalsa, 2002; Anderson & Cartafalsa, 2010; Anderson & Cartafalsa, 2012; Bradford & Wyatt, 2010).   This apparently presents a research gap in the effective teaching and learning landscape. Therefore, while the debates for appropriate teaching and learning methods still continue, and in the wake of the prospect of unavoidable and increased invasion of digital technology in teaching and learning, an investigation regarding the apt teaching and learning method particularly in engineering education is warranted, which is not seen much research. Therefore, the objective of the paper is to examine the relevancy of the current teaching methods and their impact on student learning in engineering education. The study was conducted by using a survey research method and using a case study of engineering education in a University of Technology in South Africa.

The case study was performed by considering Civil Engineering subjects such as Transportation Planning, Traffic Engineering, Water and Waste Water Treatment Technology, and Urban Planning and Design at the fourth year Bachelor of Technology (B. Tech) level in the Central University of Technology, Free State, South Africa. These subjects need theoretical explanation, development of arguments, mathematical analysis, development and evaluations of simulated scenarios based on field study, and design. Therefore, they offer specific challenges of intensive engagement of teachers and students both in the class rooms and off the class rooms; and requirement of an appropriate method of teaching for effective learning and better performance by the students. Findings suggest that although use of digital methods and ICT in teaching and learning is unquestionably accepted by the students, student engagement in class room activities, which use digital methods, is appreciably lower. However, student learning is significantly higher through the use of the blended/mixed method approach (appropriate mix

of conventional and digital), particularly in modules involving mathematical expressions, analysis or design aspects.

Method

A quantitative survey research method and qualitative discussion with students and peers were used to conduct the study. The survey was conducted among the B. Tech Civil Engineering students over three consecutive semesters from the year 2013 to year 2015 using convenient sampling with a sample size of 320 (n = 320). Students from five subjects such as Transportation Planning, Traffic Engineering, Water Treatment Technology and Waste Water Treatment Technology, and Urban Planning and Design were chosen for the purpose of the survey. The sample size varies in different subjects from a minimum of 10.94% (Waste Water Treatment Technology) to a maximum of 29.06% (Transportation Planning), however is proportionate to number of students in the subjects. Survey questionnaires have been prepared and distributed among the willing students at the end of the semester to provide their feedbacks on different attributes of teaching and learning process and methods of a particular subject. The survey questionnaire includes teaching learning attributes like the students' preference of teaching methods, level of use of digital technology, use e-learning resources, use of e- learning platforms, participation and engagement level in the class under different teaching processes (particularly during discussions, explanation by writing on the boards by teachers, watching Videos, presentation and instructions though PowerPoint presentations) by the students and their perceptions on the influence of different methods on their effective learning and performance in the subjects. The attributes were evaluated by using a five point Likert scale ranging from 1 to 5 where 1 indicates very low influence and 5 means very high influence (1= very low, 2= low, 3=acceptable, 4= high and 5 = very high).

Besides, qualitative discussions were conducted with students and peers regarding the use and effectiveness of different teaching and learning methods including the use of e- learning platforms and resources as well as their influence on student performances. The discussions were done in semiformal and non-structured ways by following a snowballing approach to compile the opinions over the three years. The data collected were analyzed statistically by using descriptive statistics (mean, and Standard Deviation), and significance tests to establish the relationship between the teaching and learning methods and effective student learning.

Results and Discussion

The influence of various attributes of different teaching and learning methods and use of various tools and techniques were assessed based on the mean scores obtained from the results of the Likert scale evaluations. The evaluations were done under four crucial teaching and learning challenges, such as acceptance by students, student engagement, level of use by students and perspective influence on effective learning. The important attributes evaluated are use of conventional method, use of digital method in general, use of blended method, PowerPoint presentations, use of Videos, e-learning platform-Blackboard, e- learning resources through Blackboard, Web-linked resource, and assessment through Blackboard.

Table 1 presets the mean scores and standard deviations (SD) obtained from the Likert scale evaluations of different attributes of teaching and learning methods and tools and techniques on the four teaching and learning challenges. The lower SD values indicate that the results obtained are consistent and can be used for assessment of the influence of the teaching and learning methods and their attributes on effective learning process. The examination of the results revealed that students accept both conventional and digital methods of teaching and learning although the digital methods (LI=4.01) is relatively more acceptable than the conventional methods (LI=3.38). However, the blended method of learning with appropriate mix of conventional and digital method is most acceptable (LI= 4.24) by students. Similarly,

use of PowerPoint presentation (LI= 4.08), Videos (LI= 3.84), use of e- learning platform (Blackboard) (LI= 3.85) and e- learning resources through Blackboard (LI= 3.91) have definite acceptance. However, Web-linked resources (LI= 2.6) and assessment through Blackboard (LI=2.53) are not preferred. Student engagement in the class is found to be relatively higher in case of use of blended method (LI= 3.60) followed by conventional method (LI= 3.57) than use of digital method in general. Also, an acceptable level of student engagement is observed in case of use of Blackboards. However, the student's engagement is found to be lower in case of PowerPoint presentations, use of Videos, accessing e-learning resources from Blackboard, Web-linked resources and assessment through Blackboard. Findings also suggest that both conventional method (LI= 3.56) and blended method (LI=3.56) are equally used in the teaching and learning process. Digital method independently (LI= 2.97) is relatively less used. However, PowerPoint presentations (LI= 4.05) is the predominant mode of instructions in the classes closely followed by use of blackboard (LI= 3.81) and accessing of e- learning resources through Blackboard. Accessing of Web-linked resources and assessment through Blackboard are marginally used. On the issue of influence of the teaching and learning methods and use of tools and techniques on the effectiveness of the learning and student performance, students perceive that blended/mixed method (LI= 3.50) influences most. Both conventional method (LI= 2.70) and digital method (LI= 2.98) independently have relatively less influence. Besides, use of Blackboards, PowerPoint presentations, accessing resources from Blackboard have acceptable level of influence on the effective learning. The influence of Video presentations, Web-linked resources and assessment through Blackboard on effective learning is observed to be low.

Table 1 Perspectives of teaching and learning methods towards acceptance, engagement, level of use and effectiveness in learning

Teaching and learning methods and tools and techniques	Likert scale evaluation results (LI)							
	Acceptance by students		Student engagement		Level of use by students		Perspective influence on effective learning	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Conventional method	3.38	0.60	3.57	0.57	3.56	0.54	2.70	0.37
Use of digital methods in general	4.01	0.93	3.03	0.29	2.97	0.40	2.98	0.44
Blended method	4.24	1.05	3.60	0.59	3.56	0.55	3.50	0.54
PowerPoint presentations	4.08	0.96	2.97	0.31	4.05	0.94	3.10	0.34
Video presentations	3.84	0.78	2.93	0.30	2.60	0.28	2.95	0.31
Use of e- learning platform/ Blackboard	3.85	0.81	3.35	0.51	3.81	0.77	3.32	0.47
Accessing e-learning resource through Blackboard	3.91	0.78	2.98	0.29	3.83	0.73	3.17	0.40
Accessing Web-linked resource	2.61	0.15	2.50	0.11	2.41	0.33	2.40	0.17
Assessment through Blackboard	2.53	0.17	2.25	0.23	2.24	0.14	2.21	0.20

However, significance tests between the effective learning and the three different teaching methods were conducted to establish the most appropriate method of teaching and learning conclusively. For the purpose effective learning is measured by the overall student performance (marks acquired after the final assessment that includes both formative and summative assessment). The t- tests for $\alpha < 0.05$ was conducted on aggregate basis based on the perceptions of the students regarding the level of use of the teaching and learning methods and their performance after the final assessment. For this purpose the

students' perception on the level of use and their performance in the subject are groups into ten groups on an aggregate basis. The t- test result is found to be significant (p values for both one tailed and two tailed ≤0.05 for α < 0.05) in case of blended teaching and learning method establishing that higher student performance or in other words effective student learning can be attained through blended method of teaching and learning (Table 2). However, the t-test results are found to be insignificant (p values for both one tailed and two tailed ≥ 0.05 for α < 0.05) in case of relationship between either conventional method or use of digital methods alone and effective learning indicating that effective student learning may not be attained if either method is used independently.

Table 2 Relationship between effective learning and methods of teaching

Teaching and learning methods	Effective learning				
	df	T values	p*	p**	Significance
Use of blended method and Performance of students	9	-5.59	0.00162	0.00324	Significant
Use of conventional method and student performance	9	-0.66	0.26	0.52	?
Use of digital methods alone	9	-0.52	0.31	0.62	?

(Note: * one tailed, ** two tailed p valued for α < 0.05)

The critical examination of the results have shown that students although accept both digital and conventional method of teaching and learning, the student engagement and effective student learning are conclusively higher when blended method of teaching and learning is practiced. Students also accept, and use all the modern tools and techniques such as e- learning platforms, accessing e-resources through Blackboard, PowerPoint presentations and Videos at an acceptable level, although they apparently participate and engage less, particularly in the class rooms. A discussion with the students also point out that their level of participation and engagement increases, they understand better and learn more when critical elements of the subjects such as mathematical expressions, analysis, modelling and design elements are explained by the teachers by use of conventional methods[1]. They argue that since many engineering subjects encompass a significant amount of mathematical, analytical and design components, PowerPoint presentations, Videos, and e- resources although enable them to access the materials repeatedly and at their own time do not substitute the explanations usually made by the teachers in the class rooms through conventional methods. In this context, teachers (peers) opine that it is more convenient and easy to explain such elements by use of conventional methods than use of digital methods alone and according to their experience students learn more under such practices[2]. As argued by scholars digital technology has taken learning and teaching into a new realm (Anderson & Cartafalsa, 2012; Caywood and Duckett, 2003; Subramanya and Jolla, 2012). Keeping pace with the incorporation of technology in teaching and learning process, there is a need for change the style, shift in attitude, and adoption of appropriate methodology to achieve effective learning (Subramanya and Jolla, 2012). Consequently, an argument has emerged based on the ground realities that engineering subjects because of their nature and content need teachers' explanations in the class rooms through use of conventional method that is evidenced from this study. This supports the view that traditional deductive way of teaching and learning, which begins with presentation of basic principles in lectures, explanation- may be by use of conventional board and marker, repetition and application of the lecture content by the students augur well for engineering subjects (Prince, Felder, 2006). Thus, it is advocated that although digital methods of teaching and learning is on the rise and continue to get strengthened in future, the role of conventional teaching and learning method cannot be undermined particularly for engineering subjects. So, as evidenced from this study a blended method of teaching and with appropriate mix of digital modes

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[1] Qualitative discussion with students
[2] Discussions with peers

such as PowerPoint presentations, Videos, use of e-learning platforms, use of e- learning resources, and conventional way of explaining in the class rooms by use of board and markers would engender effective learning by the students.

Conclusion

Finding an appropriate method of teaching and learning, particularly in engineering education is a challenge. The increasing invasion of digital technology and the aggressive promotion by the academic managers and educational technology industry for its increased use in almost every sphere of teaching and learning make it more complex. There is no denying about the benefits and specific advantages of both conventional and digital methods of teaching and learning; however, there was a need to examine if these methods engender effective learning and higher student performance when adopted independently and what are the students' perceptions towards them. Besides, most of researches on the teaching and learning methods are directed towards investigating students' satisfaction than finding out their influence on effective learning and students' performance. These research gaps warranted this investigation. A survey method and qualitative discussion with students and peers were adopted for this purpose. Findings suggest that there is definite acceptance of both conventional and digital methods of teaching and learning by the students. Students accept and use digital technology methods and tools and techniques such as PowerPoint presentations, Videos, e learning platforms and e- learning resources at an appreciable level. However, the level of participation and engagement of students particularly in the classes are appreciably less when digital method and tools and techniques are adopted. This happens because of the availability of the resources and contents at hand of the students, and students think that they can use them at any time and at their convenience. In the process they fail to get engaged with the critical explanations and discussions that are made in the class, which in fact hinder their learning later on. Besides, use of Web-linked resources and assessment through use of digital platforms are yet to be profusely accepted by the students. Conversely, students also preferred conventional form of teaching- explanation of critical aspects of the subjects such as elements involving mathematical expressions, models, analysis and design through use of age old board and marker systems. Findings of this study also suggest that effective learning or enhanced student performance cannot be attained if either conventional or digital method is employed alone in teaching and learning process; however, on the contrary this study conclusively establishes that effective learning and higher student performance can be achieved by use of blended method of teaching and learning with appropriate mix of both conventional and digital methods.

The study has its limitations. It is conducted based on predominantly students' perception and convenient sampling through a case study of a few Civil Engineering subjects at the B. Tech fourth year. Besides, the scope was limited to observing the apt method of teaching and learning and influence of different tool and techniques for effective student learning. The relative influence and contribution of different methods, tools and techniques towards effective student learning were not investigated, which are the further scope of the research. However, despite the limitations the study established that student learning is unquestionably higher if mixed or blended method (appropriate mix of traditional and digital), is practiced in teaching and learning process in engineering education.

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A STUDY OF THE STATUS AND THE ROLE OF TOURISM IN THE EDUCATIONAL SYSTEM

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Abstract:

This study aims to investigate the functions that tourism performs and the obstacles it encounters in developing educational system in Iran. This qualitative research employed open interviews to collect data. Data were collected through purposive sampling method by considering diversity principle and saturation (the researcher reached at the saturated model with 31 people). Data were analyzed by open, axial and selective coding based on which the qualitative model of this research was designed. Results conveyed that the most significant roles of tourism in education include its contribution to social, ethical, and religious development; constructive learning; political awareness; and development of economic skills. Moreover, the major obstacles in the way of development of tourism in the educational system include a fear of cultural assault, and problems related to the infrastructure, security, and belief system, as well as the negative mentality.

Keywords: *educational tourism, roles and obstacles of tourism in education, educational system.*

Introduction:

Culture is an indicator and method of living that a society chooses in order to meet its fundamental needs including those of sustenance and societal order (Nabavi and Karimi,1970, Alaghehband 2009,). The crevice between individuals or the so-called "melting point" of interactions is essentially cultural (Huntington and critics, trans. Amiri, 2007). Education is among the social institutions related to societal, scientific, political and cultural developments. In other words, the properties and function of an educational system is determined by those of its context (Sajadi, 2005). Therefore, the role of an educational system is inevitably determined by various factors a very significant one of which is the cultural determinant. Culture is pivotal in the functioning of any educational system and its influence cannot be marginalized. The relationship between culture and education is reciprocal as they form and modify each other in their turns. They are closely related and in constant negotiation.

The educational system is selected according to the national identity and cultural context of a society; that is to say, ignoring culture is not feasible at all. Cutler is a comprehensive and general set embedded in the social institution and it encompasses several sub-stets one of which is tourism.

The categorization offered by World Tourism Organization (W.T.O.) classifies tourism into different categories including educational, cultural, natural, commercial, religious, and sports tourisms. As it can be observed in this categorization, educational and cultural tourism are items in this classification. The establishment, sustainability and development of tourism require education in any society. Tourism was considered to be an economic and commercial phenomenon in the past but today it is regarded from other aspects among which is the educational angle. It discusses the appropriate method for learning in the educational system (Ritchie 2003, 11). Educational tourism refers to any journey in which the traveler's main goal is to directly engage with education in her destination (Bodger, 1998, 28).

School's educational tourism includes all school travels for primary and secondary students of 5-18 years of age. Language institutes that take learners abroad for language acquisition are instances of this kind of tourism. School's educational tourism includes local and international trips as well as student exchange programs. School trips can be divided into two categories: first, those trips required by the curriculum and directly related to syllabi. These trips supplement and further develop and elaborate official learning. Second, extracurricular trips which are not required by the curriculum and are not related to any regulations or any specific courses (Pitman et al, 2010)

Many philosophers, including Plato, Lock, Comenius, and Rousseau, believe in an education that is harmonious with nature. Likewise, Islamic teachings also consider nature to be a source of development for human beings. Humanity encounters various challenges today many of which can be solved in case a constructive human-nature relationship is established. Revising the curriculum, changing the atmosphere of primary schools, paying attention to trips for students and dedicating a budget to them, and establishing natural educational environments are among the strategies to promote natural education (Shamshiri, 2006).

Therefore, tourism has a significant status in the educational system. Actually, education and tourism can be wisely intertwined to furnish the way for planning and investment toward stable peace as is called for in the United Nations Charter to protect future generations against the plight of war (Ghasemi Rahimbaglou and Vali Shariatpanahi, 2012, 28).

Methodology:

The current study is a qualitative research. The analysis was conducted in five stages: normal coding, conceptualization, open, axial and selective coding. Normal coding and conceptualization are two prerequisites for data analysis and open, axial and selective coding stages actually constitute the theoretical coding in this theory.

Results:

This study aimed to answer the following questions:

1. What is the role of tourism in improving the educational system according to scholars and teachers?
2. What obstacles impede tourism in education according to scholars and teachers?

All the responses/sentences of scholars and teachers were coded separately for these roles and obstacles.

Conclusion:

This pioneering research was conducted in order to identify the role of tourism and the obstacles it encounters in its development in the Iranian educational. Nine teachers and twenty two scholars of tourism and education were interviewed.

The results conveyed that, according to scholars and teachers, the role of tourism in the system of education is to facilitate the comprehensive (i.e. cognitive, societal, emotional, physical and personal) development of students and the main obstacles in its development include the inefficiency of cultural and economic/budgetary infrastructures.

Discussion:

The results of interview coding conveyed the roles of tourism in the educational system according to teachers and scholars. It can help social, ethical and religious development, constructive learning, motivational role, acculturation, political awareness and development of economic skills (Figure 1).

Figure 1. Role of tourism in the educational system
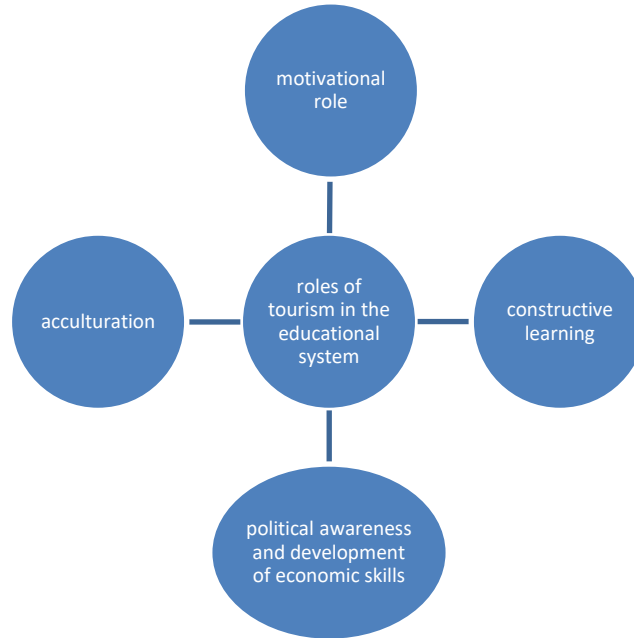
The results of interview coding also showed that cultural assault, infrastructural shortcomings, economic difficulties, security and religious issues, as well as negative mentality toward tourism are among the obstacles in the way of fulfillment of the role of tourism in the educational system (Figure 2).
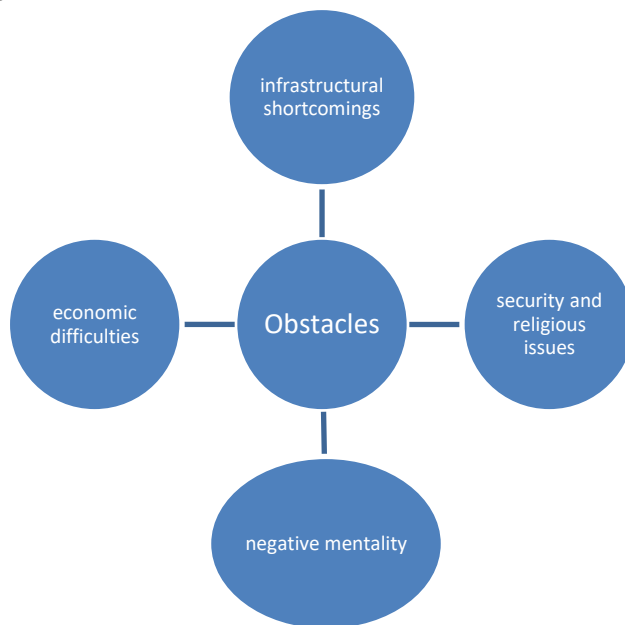

Figure 2. Obstacles in applying tourism in the educational system

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THE LOCAL ERASMUS MUNDUS PROGRAM OF PANGASINAN STATE UNIVERSITY: A RESPONSE TO ASEAN AND GLOBAL ENGAGEMENT

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Introduction

The ERASMUS (European Region Action Scheme for the Mobility of University Students) Program is a student exchange program in Europe which commenced in June 1987. The program is launched to support mobility of higher education students and teacher within Europe. It means that students of different universities in Europe can study for a semester as part of their curriculum to another university within Europe. It is named after the 15th century Dutch Scholar and Philosopher, Desiderius Erasmus of Rotterdam.

Erasmus Mundus Program is another student mobility program similar to Erasmus program. This student exchange program is open to non-European students whereas the Erasmus Program caters only European students. Its objective is to globalize borderless European education. It encourages non-European students to take higher degree courses in European Universities. The Erasmus education experience of exchange students has cultural impact. It creates a diverse community among European and non-European students in facilitating learning, understanding, and socialization. It also aims to establish and strengthen global ties of European higher education.

Background

Anchored on the principle of the Erasmus mundus, the Pangasinan State University, one of the members of the National Network of Normal Schools (3NS) in the Philippines adopts and localizes the globalized program of Erasmus mundus. The Local Erasmus Program for Future Teachers (Student Mobility Program) aims to allow the flow of knowledge, academic expertise and cultural experiences among the 3NS member schools through student exchange program. This is in response to the expected student mobility in 2015 envisioned in ASEAN cooperation of having one community and one identity. Likewise, local mobility of students had started as a result of the changes brought about by globalizing society and the deluge of modern technology. With these changes, future teachers would be expected to handle more diverse population of students in the classroom and deal with new trends, thrusts and issues in education. Best teachers should be trained with all the necessary skills needed to address societal needs. Normal schools must be able to select and prepare teachers for the Local Erasmus Mundus. Networking with other normal schools could provide exchange of resources and human capital to produce outstanding teachers. Hence, this program should be implemented in consortium with the 3NS member schools.

The objectives of the local Erasmus Mundus Program are the following:
1. To provide for a comprehensive exchange of academic expertise, research collaboration and extension programs that will strengthen the partnership of 3NS member schools through the student exchange program.

2. To provide students of 3NS member schools with rich cultural experiences by exposing them to the various local settings, developing among them the respect for cultural differences and practices.
3. To develop excellent future teachers well-grounded with skills learned from their exposure to varied learning environments.
4. To create an innovative scheme for setting the standards of quality teacher education among the 3NS member schools.

The subject offered in this program is Practice Teaching which is the common course being offered by the member institutions. The 3NS member schools in a consortium scheme that implemented the local Erasmus Mundus are the Philippine Normal University (PNU), Bicol University (BU), Bukidnon State University (BSU), Cebu Normal University (CNU), Leyte Normal University (LNU), Mariano Marcos State University (MMSU), Palawan State University (PalSU), Pangasinan State University (Pang SU), West Visayas State University (WVSU), and Western Mindanao State University (WMSU) . These institutions are formerly normal schools (Teacher Education Institutions) which until now are operating as the leading teacher education institutions in the Philippines subsidized by the government and awarded as centers of excellence in teacher education. Some had remained as teacher education institutions while others became comprehensive universities.

Student selection, Funding, and Support

The local Erasmus Mundus Program selected prospective students with the best qualifications. Primarily, the 3NS started the mobility of students for pilot testing in two cohorts following the academic year, one cohort for every semester. The first cohort started on June 2012 and the start of mobility for the first cohort was on November 2012 in which Pangasinan State University implemented. The second cohort on June 2013 and the mobility started on November 2013. The first cohort of students followed a one semester student exchange among 3NS member institutions. The continuous flow of students followed since the program has been established and institutionalized among 3NS member schools.

Student applicants had a chance to become scholars in this program, thus criteria were set to select the best students who will participate. Student applicants followed the admission policies and requirements of 3NS member schools. Additional criteria were required for student applicants. Hence, the student applicant must:
1. Have a good academic record in high school (no grade lower than 80 and with the average grade of 85) (for scholarship holder, and average grade of 87 should be maintained in the duration of the scholarship;
2. Have passed the entrance requirement of the university where he/she will start his/her residency;
3. Be in good health;
4. Be able to pass the interview; and
5. Be of good moral character.

The student applicant must submit the following requirements:
1. Accomplished application form;
2. Result of entrance examination and interview;

3. Copy of High School academic record;
4. Letter of recommendation from two former teachers;
5. Medical Certificate; and
6. Certificate of good moral character from the Guidance Office.

Also, the following are the benefits of the scholarship holder students:
1. Free tuition fee and other miscellaneous fees;
2. University accommodation; and
3. Monthly stipend.

The initial implementation of the program required financial support. The sending University to other Universities sponsored their scholars. The University chose the best students in the region to provide them the best training from the ten (10) normal universities of the country. Moreover, its target was to get the best students to become excellent teachers in their respective discipline who will be expected to teach in their region. Since the program has been properly institutionalized, the students' mobility and exchange has been implemented among the 3NS member schools following the regular admission of students in the 3NS member institutions. The 3NS member-universities supported each other in all the needed resources to jointly run this program.

Obligations of 3NS Member - Universities and Students

The following are the obligations of the 3NS Member Universities for the proper implementation of the program:
1. Deliver the program following the agreements made by the participating 3NS member schools.
2. Provide the students with relevant student information pertaining to the qualifications and responsibilities of the students enrolled in the program.
3. Inform the students about their performance, timetable applied by the 3NS member schools as well as the performance threshold required to continue participating in the program.
4. Offer the students enrolled in the program all normal services offered to their local students (library services, internet, sports facilities, social and student services, etc.)
5. Inform the students about the payment scheme and timetable and facilitate their enrolment in the designated normal university.
6. Organize the classes and ensure the expertise and availability of the faculty who will teach the prescribed courses for the semester.
7. Provide the student with the necessary support to facilitate his/her mobility to, and installation in the different hosting normal universities.

Likewise, the student is obliged to:
1. Attend and actively participate in the program in accordance with the relevant requirements of the host normal school where the student is enrolled.
2. Deliver the expected outputs in accordance with the course/degree requirements.
3. Reach the expected performance results in order to be allowed to continue participating in the program.
4. For scholarship holder student, he/she must accept that the scholarship will be withdrawn if his/her obligations as student scholar has not been met.

The Local Erasmus Mundus Program

Inspired by the Bologna Accord in Europe which opened "cross border education" and created "common education space", the local Erasmus Mundus Program of Pangasinan State University prepares the roadmap for higher education cooperation even as it anticipates greater regional cooperation with the advent of ASEAN 2015.

Through the 3NS (National Network of Normal Schools) resolution signed by the ten (10) presidents of the member schools in October 2012, the piloting of the local Erasmus Program took off during the 2nd semester of 2012-2013 and involved the practice teaching course for senior pre-service students.

The Pangasinan State University's Local Erasmus Mundus program was implemented during the 2nd semester of 2012-2013 with five (5) pre-service teachers who qualified based on the criteria set forth by the committee. All in all, it has mobilized 20 pre-service teachers to four (4) co-member Universities in the country; the last batch was on March 2016. Out of the twenty (20) pre-service teachers as scholars (from November 2012- March 2016) deployed, nine (9) enrolled in the Bachelor in Elementary Education and 11 in the Bachelor in Secondary Education with specialization in English (2), Mathematics (4), Physics (1), Biological Science (1) and Social Studies (3). These pre-service teachers were interviewed by the author before and after their deployment to other Universities. Other tools employed to gather information from the scholars were class observations, portfolio assessment, and focus group discussions.

To further discuss the Erasmus Mundus Program, the pre-service teachers were asked to answer the following questions to elaborate on their experiences as student-exchange program grantees, and these are:

1. What are the best practices that you got which prepared you as future teachers?
2. How does the program prepare you for ASEAN and global engagement?
3. Which part of the program do you consider significant to you as an exchange student and future teacher?
4. What are the problems did you encounter during the program?
5. What possible solutions can you propose to improve the program?

Findings and Discussions

Best Practices Learned

The students said that being an exchange student to other Universities was the best experience they got from the program because it enriched their knowledge and teaching experiences, thus, made them better prepared in the field of teaching. They gained a lot from the host University things that they did not meet and learn from their school. Dealing with other people from distant places, according to them was very rewarding, and it added up to their knowledge and adventure to different geographical settings. The exposures they got to entirely new environment pushed them to adopting different cultures of the people. As one of them said, "Our learning became better because we learn together-with our students, cooperating teachers, and even the community people. One learning we got was the assistance

we received in dealing with the rising standards in the school, increasing diversity, new technology and classroom management." "Classroom management ", according to the students, was one of the most important topics for them-an important skill because it balances teaching with non-instructional duties like communicating with parents, filling out attendance and responding to each day's queries of students and parents and other functions. The conduct of pre and post conferences had made them aware of what they are supposed and expected to do in their teaching and helped them evaluate ourselves on how far have we gone to the limit of our teaching every day. It helped them renew our daily vows to commit ourselves to teach students in the best possible way they can do. Another best practice they gained was the mentoring style of teaching. According to the students, they do not only mentor their students, but they extend it also to their co-practice teachers. "Exchanging of notes" with one another had enriched their knowledge in the content, but they discovered that the best learning can be achieved through multi-disciplinary-practice teachers who came together to contribute insights in the subject or topic being discussed. The use of multi-media presentation in teaching is one strategy that enhanced learning among their students.

The Program as preparation to ASEAN and Global engagement

The onset of ASEAN integration in 2015 introduced the concept of borderless education among teachers and students. The pre-service students mentioned that the program was very beneficial to them. It gave them the opportunity to explore other places, people, technology, and environment. It has deepened their understanding and respect to other cultural viewpoints and behaviour which they considered essential to the promotion of intercultural awareness and appreciation. Further, the program provided them with much needed chances to assume all the responsibilities of a high school and elementary teachers at multiple levels. The 21st century skills expected of them like collaborating, critical thinking, communicating, connecting and creating are somehow, deepened in the course of their training; they considered all of these skills very vital in their future engagements with their ASEAN and global counterparts.

The respondents further mentioned that the kind of curriculum they had has embedded the relevant topics needed to embark in a globalized undertaking. It has integrated special topics in the different subjects that tackle issues and trends of globalization. Part of the students' preparation was their attendance to local seminars and trainings focused on ASEAN and global perspectives; meetings with foreign student-visitors in school, and conduct of student's fora and assemblies to discuss foreign concerns.

Significant phases of the Program (Practice-Teaching)

Since the Practice-Teaching is the heart of the Local Erasmus Mundus Program, a matrix is presented to determine the different phases to ensure the effective training of the pre-service teacher. This comprehensive Practice-Teaching Program is structured with the following major parts: On-Campus (with Laboratory Schools), General Organization and Orientation, Actual Teaching/Off-Campus, Briefing, Mid-Conference and the General Evaluation.

MATRIX ON THE NATURE OF PRACTICE TEACHING

Phases	Duration	Specific Concern	Features
1. On-Campus	6 weeks	Done in campuses with laboratory schools	ST builds a concept of an ideal teacher.
2. Off-Campus	**16 weeks** (without lab. Schools)	Done in selected cooperating schools	Gradual induction to full time teaching is observed. • Observation of Routinary Activities with Demo Teaching • Full Teaching • Final Demo/ Evaluation of Teaching Performance • Accomplishment of School Records
3. General Orientation and Organization	1 week	Conducted by the Practice Teaching Supervisor / Supervising Instructor	Acquaint student teachers with the objectives and scope of the Practice Teaching Program
4. Briefing for Off-Campus	1 day	Conducted by the Practice Teaching Supervisor	Conducted before STs are deployed in cooperating schools
5. Actual / Full Teaching	**12 weeks** (without laboratory Schools) **8 weeks** (with laboratory Schools)	Cooperating school provides an ideal learning environment	Student Teachers are exposed to more realistic learning situations
6. Mid	1 day	Conducted by Practice Teaching Supervisor one month after deployment	To thresh out problems and concerns met during the off-campus teaching
7. Evaluation Phase	1 week	Conducted by the Practice Teaching Supervisor during the last week of the practice teaching course	Measurement to a degree on some positive changes in the student teacher Organization and Assessment of Portfolio

Problems encountered during the Program

In the course of the program implementation, the students mentioned that there were also problems and difficulties that they met. These barriers, according to them, had somehow affected their behaviour, perspectives and prospect in the field of teaching. These problems and difficulties are: (a) adjustment to a new environment, (b) non-familiarity with the place, (c) language barrier, (d) limited teaching facilities, (e) limited financial support, safety and security, (f) adapting to new teaching methodologies and learning styles of pupils and students and (g) very limited time for students' orientation on how the activities will be carried out

Suggestions to Improve the Program

From the given problems and difficulties encountered, the students suggested the following to improve the program, and these are: (a) more improved scheme to source out funds for the student-scholars; (b) more sponsors, other than the University, for financial assistance; (c) orientation-seminar for the student-grantees to focus on the preparation for the activity, the profile of the University where they will be deployed, and the language or dialects used in the region; and (d) seminar on new teaching methodologies and learning styles.

Conclusion

The ASEAN integration and globalization has brought significant changes in the lives, not only to teachers but to the learners-students as well. A very dynamic process of innovations and creativity in the field of education, globalization has interwoven interconnectedness of nations and expanding cultural exchange via the internet, mass media and travel.

Based on the experiences cited by the student-grantees, the Erasmus mundus program provided an avenue to become better and well-prepared teachers, and one aspect is the enhancement of their competence and enrichment of cultural background. Despite the presence of problems encountered, the Erasmus mundus program speaks of an innovative strategy in the whole learning process and total development for future global teachers. The program encourages mobility and cooperation between state-funded teacher training institutions and promotes them to be a nation-wide as well as world-class teacher education institutions of academic excellence, thereby, contributing to the sustainable development of teacher education in the country and in the enhancement of students' career prospects.

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LEADERSHIP AND MENTORING FOR EFFECTIVE PEDAGOGICAL TRAINING IN NIGERIAN UNIVERSITIES

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Abstract

Higher education plays a vital role in economic and socio-political development of any nation. It is on the basis of this that everything that could enhance, promote and sustain pedagogical training at this level must be treated with utmost importance. Leadership and mentoring of lecturers in the Universities become imperative and germane in all facets. This paper therefore examined how leadership and mentoring can help alleviate the barrages of problems encountered by the lecturers in the universities, particularly in their teaching and research. Such problems revolve round issues such as having the right disposition to pedagogical work, ability to employ the right teaching method in enhancing effective learning and knowledge acquisition by students, maintaining academic integrity, and writing good and acceptable academic research papers and coping with academic stress. It is, therefore, recommended that the university management should pay utmost attention to leadership and mentoring and accord it great importance to enhance effectiveness and excellence in our universities. Qualified and trainable lecturers must be employed to facilitate thorough pedagogical training.

Keywords*: Leadership; Mentoring; Pedagogy; Research; Academic Integrity.*

Introduction

Federal Republic of Nigeria (2014) in its National Policy on Education highlighted some aims of higher education to include the development of intellectual capacities of individuals to understand and appreciate their environments and the acquisition of both physical and intellectual skills to develop into useful member of the community.

The alleged decline in the quality of university education has raised concern from many stakeholders. Education is an investment that takes a lot of resources from the government for capital development. The government in return awaits the success of such an investment through the performance of the finished product from the Universities.

Leadership plays a vital role in any organization. Without effective leadership, the boat of any University could capsize. The success or downfall of any organization is often attributed to the leadership. Thus, the brain behind any successful and achievable progress made by the University is the leadership. George and Kent (2009) saw leadership as leaving a mark, initiating and guiding; and the result is change. By their ideas and deeds, leaders show the way and also influence the behaviours of others (House, 2002). Leadership is action and not a position, since a leader shows somebody or a group how to do something.

Effectiveness has often been used to measure the achievements of leader in many instances. Mullins (2005) posited that effectiveness is concerned with doing the right things and this relates to outputs of the job and what the leader actually achieves. Effective leaders are defined in terms of the quantity and quality of standards of performance, satisfaction and commitment of subordinates.

The manner in which the leader achieves results and the effects on other people is equally very important. Mullins (2005) opined that two current methods of management development which are being advocated

are the skills of mentoring and coaching. Leadership and mentoring are interdependent as mentoring can be regarded as one of the tools for effective leadership, most especially in the Universities.

What is Mentoring?

According to Mullins (2005), mentoring is a current method of management development being advocated for mentees to be effective on the job. This is very essential in the University environment as lecturers need to be effective in the pedagogical activities. It is also a way to learn and acquire the skills that are necessary to be effective on the job. Mentoring is an essential leadership skill to managing and motivating people, it is also an important way to help others learn, grow and become more effective on their jobs.

Bullough and Draper (2004) saw mentoring as close, intense, mutually beneficial relationship between someone who is older, wiser and more experienced and more powerful with someone younger or less experienced. From all these definitions, one can establish the fact that mentoring is a relationship between two people: "the mentor and the mentee". The mentor is more knowledgeable, experienced and qualified than the mentee while the mentee is willing to tap from the wealth of experience of the mentor. Hezlett (2005), Lankau & Scanduia (2002) and Young & Perrewe (2004) noted that mentoring is an endeavor for institutions to use and share human capital, knowledge, and share job related support. The University is a social organization where members are interrelated in the performance of their duties. Leadership and mentoring are inevitable in institutions, without which institutions will falter in times of change. The organization will be dormant or a terrible crash will occur as the group goes in a wrong direction (George & Kent, 2009). This is to say that the onus is on the senior academics in the Universities to expose the newly employed lecturers to mentoring for effective job performance.

Who is a Mentor?

According to Draft (2008), a mentor is a higher-ranking member who is committed to providing upward mobility and support to a protégé professional career. He provides men and women with direct training and inside information on the norms and expectations of the organization or institution. Kouzess and Posner (2007) perceived a mentor's role as a model to the mentee by demonstrating traits, skills and behaviours that mentee could emulate. They noted that whosoever wants to be successful as a leader must first model the way his constituents will look to him for the behavior, and norms of the institution. Leaders must be first by setting examples; they will thus gain commitment through their daily acts creating a momentum thus leading to progress and dedication.

Allen, Eby and Lentz. (2006) noted that a mentor is a person who has personal relationship with the mentee. Mark and Britt (2009) saw a mentor as an effective leader who must have global vision that transcends the day-to-day operations, inspire a shared vision through envisioning the future, and enlisting others in the vision.

Looking at the University, an apex of educational institution, the need for mentorship is highly essential for the attainment of academic excellence. Lecturers need a trusted counselor, coach or advisor who will provide advice and assistance to help and support members in diverse groups in their jobs, socialize them in the culture, values of the organization and pragmatically help their chances for development and advancement (Luthans, 2005).

Need for Mentoring of Lecturers

Education is dynamic and it changes from time to time in order to meet the dynamic nature of the society. Lecturers are also employed from time to time to meet the exigency of the situation. Many of these lecturers would come from various backgrounds to be integrated into the lecturing profession; hence the need for real mentoring by experienced and senior professional colleagues for effective performance. Many of the newly employed lecturers may neither have any prior knowledge of what lecturing in a university entails, nor the art of classroom communication; not having any knowledge about research work; having a vague idea about writing of academic papers, totally ignorant about getting students' result ready on time, and proper record keeping. Nothing may be known about academic integrity and many may never have been exposed to academic stress. It is expedient of the University leadership to organize for effective mentoring for lecturers for effectiveness and better performance. It will not be too much if a younger lecturer is attached to a senior colleague for mentoring.

Where Lecturers Need Mentoring

Lecturers need to be highly mentored in some specific areas to promote academic excellence and for the goal of education to be achieved at this level. A lot of research has been conducted on classroom management and lecturers' pedagogical skills to determine the characteristics of lecturers. Some findings revealed that students perceive teachers' way of classroom management, in-class and out-class attitudes, and teaching methods and strategies of pedagogical work, had positive or negative impacts on their academic success and participation in lessons. For example, Gray, Sohela & O'Rear (2015), Ingersoll & Strong (2011) noted that mentoring may be an effective intervention for improving teacher retention and performance. Research also indicated that mentoring new teachers for at least two years can positively affect student academic gains (Glazerman, Dolfin, Bleaker, Johnson, Grider, & Jacabus, 2010).

Professions also differ in cultures and ethics. The teaching profession is unique in a way because people need to be guided in right pedagogical skill for effective performance. Without a guide, the less experienced lecturers may be like a ship without a guide that will surely capsize. In addition, the less experienced lecturers need personal support different from purely professional assistance. Each individual has some emotional, psychological, spiritual, political and economic needs. If their needs are not properly guided or met, it could hinder the lecturers' professional development. It is the duty of the experienced mentors to come to the aid of the mentees by having an intimate relationship with the mentee to make them emotional and psychologically stable to meet all academic challenges; and this relationship could, gradually graduate into a never-ending and mutually beneficial relationship.

Application of the Right Teaching Methods to Pedagogy

Teaching is one of the major duties of lecturers in the University. Teaching at any level requires special technique and it is not just a simplified form of academic as many wrongly suppose. There are various approaches to teaching in the classroom setting and no single method is tagged ideal, but rather a combination of different methods would be considered ideal in teaching and learning situation even as situation demands (Omotayo, Ajay & Fatoba, 2009).

Universities all over the world attach much importance to experience and development on the job to the extent that Professors are respected as experts and authority in their area of specialization. It is expected that these Professors will share their wealth of experience and expertise with the younger lecturers

particularly in the area of application of the right teaching method to pedagogy. Successful and qualitative pedagogical work is no doubt an index of teacher effectiveness. There are various methods of imparting knowledge into students such as Lecture method, discussion method, laboratory method, playway, inquiry method, programmed method, computer-assisted method, project method, excursion/ field trip, micro teaching method, team method, etc. All these methods are good and effective means of communicating pedagogy into students. Effective application of any of these methods depends largely on the professional quality of the lecturer.

Teaching expertise is the height attained by academics in getting adequate knowledge and skills in terms of pedagogy, teaching style, methods and subject matter that enhance lecturers' teaching effectiveness. The University management should make room for younger lecturers' mentoring by attaching a younger lecturer to a professor or a senior colleague to mentor in all areas. Following older professors to class will enable the younger lecturers to learn rudiments of the pedagogy, and the various methods to be used at a particular point in time. Houle (1980) asserted that expert professors need opportunities to interact with and be observed by the novice. He further explained that professionals learn through study, apprenticeship, and experience, both by expanding their comprehension of formal discipline by finding new ways to use them to achieve specific ends, constantly moving forward and backward from theory to practice so that each enriches the others. When the younger lecturer watches the experienced professors lecture, and observe, then, expertise are robbed on the younger lecturers and gradually they learn and attain perfection.

Weber, Gabbert, Pynes (2007) observed that Universities typically do not have formal programmes to establish these types of interactions between novice and expert teaching professors. Shim, & Roth (2012) established the need for universities to systematize the ways in which novice or newly employed lecturers connect, observe, and collaborate with their older professors and that the sharing of expertise between workers and their mentees should not be left just to chance encounters. University of Virginia (2012) opined that quality teaching has been the desire of world class, hence, quality teaching lies at the heart of a good University. Akomolafe (2013) reiterated that competent and experienced teachers can especially be a valuable resource for beginning teachers as well as for other experienced teachers. Effective mentor-mentee relationship will in no small measure contribute to effectiveness of pedagogy in the universities; both the mentor and mentee would also learn from one another to enhance effectiveness and the institutional programmes would also be effective and run smoothly. Mullins (2005) corroborated this by noting that two current methods of management development which are being advocated are the skills of mentoring and coaching. He further added that one of the joys of managing others knows that one has helped others to develop and grow.

Academic Integrity and Research Work

Another area where lecturers need mentoring is in academic integrity. This seems to be the crux of lecturing job to attain effectiveness and academic excellence in the universities. Integrity refers to the level of truthfulness and tendency to translate words into deeds. Integrity is sometimes called authentic mentoring because the individual acts with sincerity devoid of ulterior and selfish motives.

According to Adebayo (2013) integrity involves the behavior and actions consistent with a set of moral or ethical principles and standards embraced by individuals as well as institutions. This implies that how a lecturer conducts himself or herself effectively in a school system is a function of his or her integrity. The

management should organize a mentor's forum to let the mentees know that academic integrity is the moral code or ethical policy of academician. This includes values such as avoidance of cheating, plagiarism, maintenance of education standard, honesty and rigor in research and academic publishing.

There are some basic facts that the university management should bear in mind when new lecturers are employed in the universities. As mentors disciple the mentees, they should be made to know that when a researcher uses other peoples' works, he or she must give credit to the author of such work. Behrman (2013) opined that writing is about marrying established facts and others insightful thoughts with your own innovative thinking. He further added that passing someone else's work as your own or referencing it without using proper attribution is known as plagiarism. Plagiarism is using someone else's words, ideas in a paper and acting as though they were your own (Hall, 2005). He further explained that it includes any form of the idea that you did not create, be it in graph, picture, words or otherwise. While directly copying ideas is the most apparent way to plagiarize, also changing a few words or re-organizing a paragraph does not negate the fact that you are not stealing someone else's intellectual property. Charlotte (2009) espoused some facts about academic honesty and integrity as the foundation of educational institutions. Without maintenance of standards of honesty, members of the instructional faculty are defrauded, students are unfairly treated and society itself is poorly served. He further added that instructors which are mentors in the context of this paper are primarily responsible for maintaining and enforcing honesty and integrity.

Charlotte (2009) also proffered solutions to how to avoid plagiarism. He noted that the best way to avoid plagiarism is to simply "give credit, when credit is due". Provide proper citation in both oral and written works when using:

(a) another person's idea, opinion or theory;
(b) any fact, statistics, graphs, drawing, any pieces of information that are common knowledge;
(c) quotation of another person's actual spoken or written words, or
(d) paraphrase of another person's spoken or written words (Indiana University, 2004)

He also added that plagiarism could ruin one's academic career.

Coping with Academic Stress

Stress is one of the most commonly issues discussed by lecturers in their various institutions nowadays and this is as a result of what they are experiencing in their places of work. Stress is individually defined and is intrinsically tied into an individual's perceptual system. Everyone has a range of comfort within which they can feel steady and safe. Stress occurs when the individual feels that they are working outside of that comfort zone (Mulins, 2005). Medical dictionary defines stress as a physical, mental or emotional factor that causes bodily or mental tension. Stresses can be eternal i.e. from the environment, psychological (or social situation) or internal (illness or from a medical procedure). Stress can initiate the "fight or flight" response, a complex reaction of neulogical and endocrinologic system. Lecturers perform various duties, particularly the younger lecturers who have to cope with different types of work ranging from teaching/ lecturing, being course advisers to students, marking of students work, conducting continuous assessment tests, getting the result of students ready, and attending to any other work assigned to them by their superior officers.

All these work stress can fag lecturers out, resulting in burnout and ill health a times.

Olorunsola (2010) asserted that an enriched environment with adequate facilities could have a magnetic effect of raising the morale and tempo of lecturers, but the absence of such necessary facilities impede the hardworking lecturers and even cause dissatisfaction and ineffectiveness or poor job performance. This is another dimension to the stress the lecturers cope with in their places of work. The environment where lecturers work is not conducive enough for the job they do. The problem of lecturer-student ratio is another stressor. There are also no specified time allotted for lecturer's relaxation such as recreational activities or time to proceed on annual leave to get out of monotony of academic rigor. Fox (1974) attested to this fact that it is a good climate that makes an institution a good place to be, a satisfying and meaningful situation in which people spend substantial portion of their time. Cooper, Cooper and Eaker (1988) identified six major sources of stress at work as

(a) Intrinsic to the job-working conditions;
(b) Role in the organization – overload, underload;
(c) Relationships at work-particularly with the boss;
(d) Career development-mid-life being a critical stage;
(e) Organizational structure & Climate-the extent of rules and regulations;
(f) Home-work interface – particularly the growth of dual career families.

Working with a difficult boss is another cause of stress which can choke life out of a worker and even encourage turnover. All these call for a proper programme of lecturer's mentoring in the institutions. It is the duty of the mentor to assist the mentee on how to cope with academic stress, so that the stress will not affect their health and consequently their productivity. The mentors should help mentees manage their time in a way that stress will be drastically reduced and effective work will still be done to enhance institutional progress.

Conclusion and Recommendation

Leadership and mentoring have been found to be indispensable tools of management development of sound pedagogy and organizational effectiveness. Mentoring has also been found useful in many professional fields like sports, medicine and law. Since teaching is also a profession, it would be of immense advantage if mentoring would be well incorporated into lecturing for effective pedagogy. A lot of benefits have been discovered in mentoring for both mentors, mentees and the institution, and for the development of the lecturers for better commitment and performance.

University is the apex educational institution in Nigeria and even all over the world. The effectiveness of any institution is the degree to which the organization achieves a stated goal and succeeds in accomplishing what it tries to do. Effective leadership is often regarded as the most important factor in the success or failure of institutions. Therefore, this is the right time for institution leaders to take mentoring programme seriously and as a matter of urgency. If the newly employed lecturers are left alone, like a ship without a guide, the tendency to sink is very sure. Hence, this paper is advocating for real mentoring programme in Nigerian universities for proper guidance as soon as new lecturers are employed. Also, capable and trainable lecturers should be employed to facilitate effective leadership and mentoring work. With effective leadership and mentoring, the level of professional development and effective pedagogy, and organizational effectiveness will be enhanced.

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EVOLVING A NUMERICAL METHODS COURSE INTO AN APPROACH BASED ON FLEXIBILITY AND RESEARCH SKILL DEVELOPMENT

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Abstract

Demand for science and engineering education is becoming a challenge for the next decades, requiring availability and quality. Despite, differences between incoming levels in the technical skills of students for the engineering programs will require optimal and differentiated schemes of instruction able to reach the desired standards in math, science, engineering and applied knowledge to solve challenging problems creating new technology. This work shows an updated version of a numerical methods course evolved from traditional teaching into technology based teaching. A blended learning approach has been settled as a differentiated and flexible scheme based on pure online approaches powered by mobile applications and face to face sessions centred on a net of research challenges. The current guidelines for the course put special attention on the research challenges being considered. The evaluation model for the whole course is particularly discussed and analysed based on a preliminary implementation.

Keywords: Numerical Methods, Blended Learning, Challenge based learning

Introduction

Two decades ago, the most of university faculty was reluctant to base Education on technology. In nowadays, technology has been improved and spread; therefore, education inevitably has become a target for information technology development (Wood el al, 2004). In the author's personal point of view, Higher Education is still an undecided terrain about clearness and overwhelming use of learning technologies. Nevertheless, there is a growing tendency to explore new technologies in the last years. Educative Apps and other applications to develop educative products have opened the road to educative innovation. Laurillard (2005, 2008) has appointed that mobile technologies are enhancing the professional learning of the disciplines. Particularly, engineering education has had a continuous adaptation introducing new technologies. The use of professional software to simulate, plan or calculate scientific and engineering processes are now frequent in the university courses, promoting computer lab components together with the theoretical class. In addition, information technology to set online Education has spread at the same time. Online education is a broad term to fit the use of online learning activities, either as written instructions or as a computational tool based activity, sometimes sharing the face to face learning (blended learning) or as part of a fully planned sequence of online activities (pure online learning). How address this technology in Higher Education? These technologies propose advanced and flexible scenarios by pursuing the online learning of basic content, supporting the face to face sessions introducing a blended approach centred on advanced learning activities.

The aim of this work is to propose and justify a blended scenario in a numerical methods course based on challenge based learning. This scenario rests on the advancements generated by mobile technology in the last five years. That evolution is letting to change the class approach into research based activities while basic content learning is mainly covered online. The second section of the article depicts the elements and structure of the course in nowadays, including the new approach based on research as a more challenge learning process. Third section shows the preliminary outcomes in the initial deployment and the visible issues emerged by introducing research projects. Fourth section discusses these results in terms of effectiveness and the fulfilment of the original pretensions. Fifth section includes the conclusions.

Material and methods

a) Numerical methods course evolution and context

Numerical analysis discipline has been evolved in parallel with technology. It has been demanded to transit from a numerical analysis course into a computer simulation course to reduce the gap between academic and professional practice (introducing real applications and specialized software to learn). Its traditional teaching has evolved in the last years with the spread of computer systems, adapting the curricula and their teaching methodology. Located after of theoretical math and science courses, this course is mandatory for the engineering programs. It was improved by the introduction of project development related to scientific visualization in a curriculum integration context (Delgado and Martínez, 2011). In addition, years ago, the author began to introduce complementary technologies in his numerical methods course, as well to those oriented exclusively to develop the planned course skills (Excel, Mathematica, Phyton, etc.). As a result, in 2011, several consolidate technologies were used to state the mobile management of course, and some additional emerging technologies to begin a mobile learning approach (Delgado, 2013). These complementary resources were first oriented to cover some learning weaknesses in the course. With the time, while public educative mobile tools were improved and spread, they have brought the opportunity to use as the main support of learning. The numerical methods course evolution is recompiled in (Delgado, 2013; 2016), reporting its development in ten years in terms of technology in class and the scaffolding of blended learning (Lothridge, 2013; DeNisco, 2014).

The most important changes in the last years include: a) the You Tube channel for the course (Delgado, 2012; Stocks, 2014) to screencast all programming topics of the course; b) open full resources based on online presentations, screencasts and basic programming codes; c) orientation to visualization and simulation with more complex problems in engineering (Delgado and Martínez, 2011); and d) online evaluation (formative and summative) for the basic contents. These changes enabled the evolution into a more flexible learning approach in terms of blended activities as alternative paths to teach and to promote skill and engineering competencies. Together, more complex and integrated research scenarios have been introduced as guideline and goals for the course. These changes have been depicted in (Delgado, 2016). This update substitutes exclusive spaces for face to face education covering basic contents learning with a pure online approach. In (Delgado, 2016) is analyzed the approach effectiveness for the basic knowledge acquisition.

b) Small Private Online Research

Massive Open Online Research (MOOR) is basically a reduced MOOC with emphasis on research. Goals and recipients are different; MOOR's are oriented to work together in teams to solve a practical problem, a better approach in a numerical methods course. It lets to students a chance to work on targeted research projects under the guidance of a researcher (Hosler, 2014). Other version of MOOC's is a Small Private Online Course (SPOC), defined as an online course based only on a segment of the university. Based on blended learning, this approach focuses on local requirements, including some face to face interactions (Goral, 2014). The current proposal for numerical methods course is labelled as Small Private Online Research (SPOR), allocated on a selected segment of university and being oriented to multidisciplinary research (numerical methods course involves students of Chemical, Mechanical, Mechatronics, Electronics. Industrial and Biotechnological Engineering programs)

An analysis was developed in (Delgado, 2016) based on: a) the newest interactions being discovered behind of the new mobile approach and b) the hidden effectiveness outcomes of blended activities as individual and predictive evaluations for the last year- By supporting the replacement of face to face instruction of basic contents dominion with a series of research problems as guideline (covering the basic contents under a pure mobile learning strategy). The motivation of this paper is to analyse the evolution

under this flexible version where each student selects their resource learning, pace and evaluation route through: a) course screen casting series through a You Tube channel included in the course site; b) extended repositories (simulations and programming codes); c) a specific interactive e-Book for the course; and d) formative or summative evaluation reached with Socrative (2015) and Classmarker (2015).

c) Research projects series

Research projects used as challenge based learning are based on short visualization tasks for science and engineering. There are three periods in the course term. A net of projects was created for the initial deployment of SPOR approach. Figure 1 shows them, each column is used in a specific semester and each row belongs to a specific period. The projects are related to Mechanics, Cellular Automata rules in biology, Heat diffusion, Electric potentials and fields, Lighting, Chaos, Complex kinematics and Bacteria growing models. In each project, several numerical methods reviewed in the course should be applied (but not exclusively) and they are expected to be developed through the online activities. The projects have some open aspect to promote innovation and specialized research in the group of students. Groups of utmost four students are created in each period to develop them as well as other previous teamwork related to the screencasts review (more challenged than individual homework but less than projects).
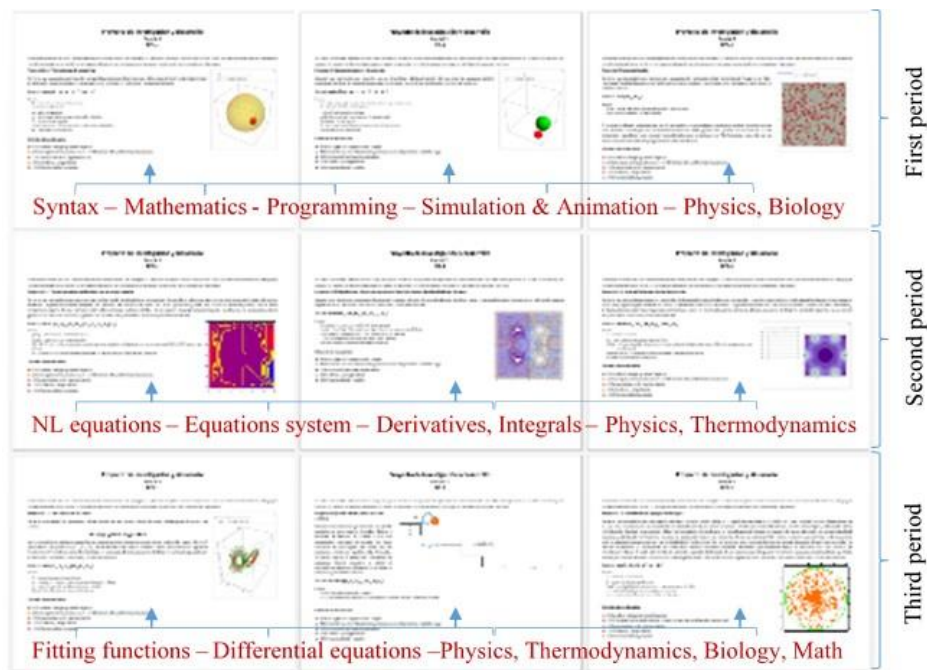

Figure 1: Series of projects constructed for the first course deployment. Only one of each row is applied during each one of three periods at the semester, as a function of the related contents.

d) SPOR global structure

SPOR approach required rearranging the traditional teaching program. To make room for the project development, a full set of screencasts oriented to programming was created. Each unit of screencasts has a teamwork review to warrant the apprehension of related contents involved. In addition, an individual homework of each unit should be developed. A unit basic skill evaluation is applied through online quizzes. Each student can present it until two times with an optional third opportunity included in the period exam. At least one of these three applications is mandatory. Each period exam has three components: the optional basic knowledge one, and two more evaluating related concepts in the

teamwork and projects. Thus, each exam co-evaluates the teamwork developed in the unit. The most of face to face sessions are oriented to develop challenging activities. Figure 2 shows these components with their grade weights.

e) Semester evolution in the course

Figure 3 shows the course's chronological development in terms of the learning and evaluation activities. An initial presentation of the numerical methods site (Delgado, 2015) is conducted at the beginning of the semester. Then, screencasts begin as blended activities, while in the face to face sessions there are a permanent movement towards the more challenge activities, but still including some aspects of concepts and theory. Homework is developed individually under tutoring. While though the period, teamwork will be developed in parallel with the period project. At the end of the period the three component exam is applied.
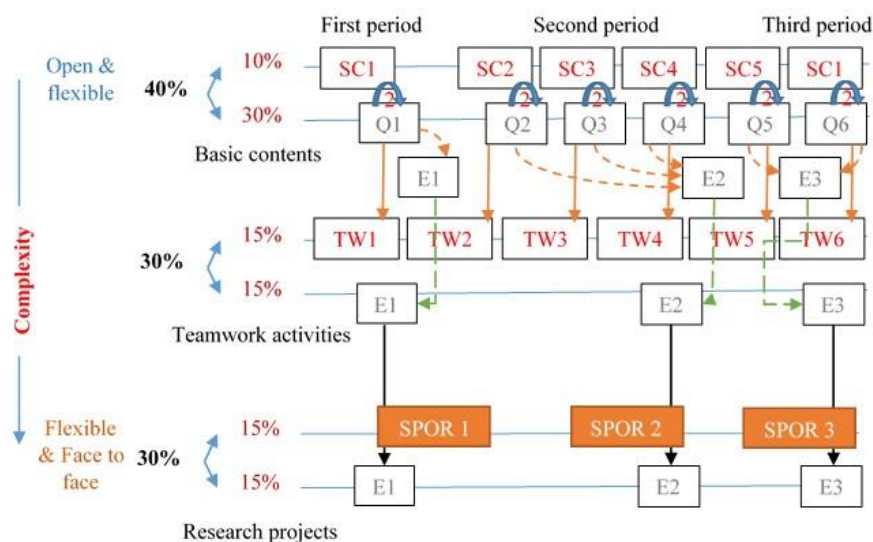

Figure 2: Whole strategy in the SPOR approach, including the grade weights of each component.

f) Measuring the student performance

One of the main concerns in online learning is related with grade discrimination between individual and team evaluation components. But this issue should be focused in a wider open way. Challenge based learning develops skills and competencies, so a stronger system of evaluation should be developed to reflect realistically this pretension. Thus, SPOR approach in the course should be validated comparing individual and team performance of several dimensions: knowledge, skills, and competencies, and using the grades assigned. In the analysis, several statistics were constructed, they are depicted in the Figure 4 in terms of learning activities: Quizzes ($Q_{a,b,c}$), Three component exam (E) –basic knowledge (Q_c), teamwork (TW) and a research project (P)-, Individual homework (HW), Teamwork as a review of screencasts (TW) and Project (P). All multiple statistics are proportionally weighted in agreement with their weights in the course grade scheme (Figure 2) and then expressed in a 100 point scale.
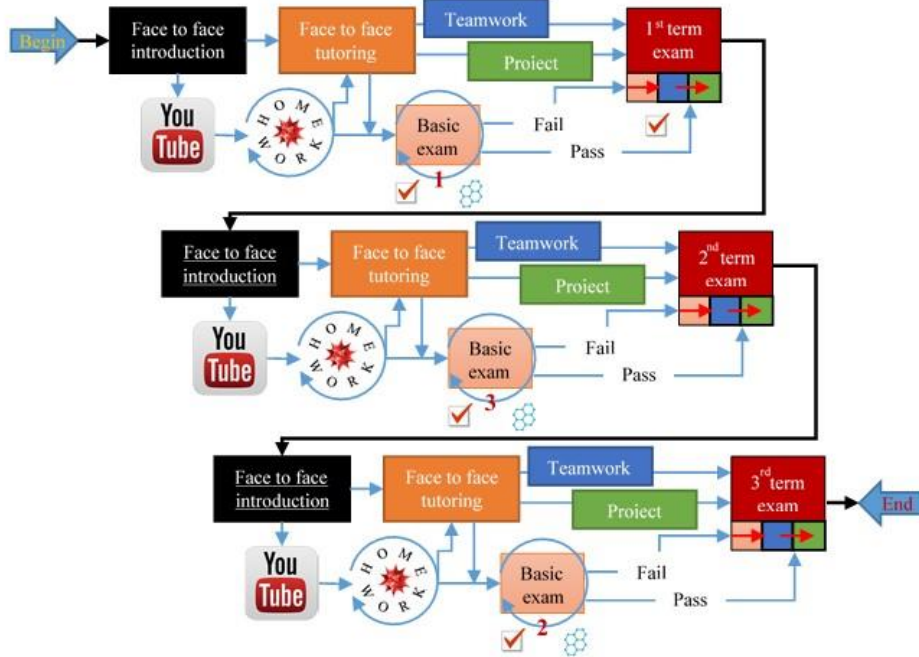
Figure 3: Summarized course activities chronology in the SPOR approach proposed.

Two analyses were conducted. The first analysis is a scatter analysis on several groups of individual evaluations for the students to observe tendencies in individual outcomes. There, two paired statistics were used. The first one evaluates the teamwork (TW, P) versus individual work through the corresponding performance in those components of the exam (E: TW, P). The second evaluates the teamwork (TW, P) versus individual knowledge components ($Q_{a,b,c}$, HW). The second analysis was based on grouped descriptive indexes (mean and standard deviation) for several variables. Among these indexes, two ($\mu_{i/t}$, $\sigma_{i/t}$) are obtained as the ratio of individual and team grades (Figure 4). The first is for quizzes ($Q_{a,b,c}$) compared with team grades (TW, P) in the corresponding periods, measuring the association between knowledge and skills/competencies. The second is for challenge components of exam (E: TW, P) compared with the corresponding team grades (TW, P), measuring the real individual skill/competencies impact on the team grade.
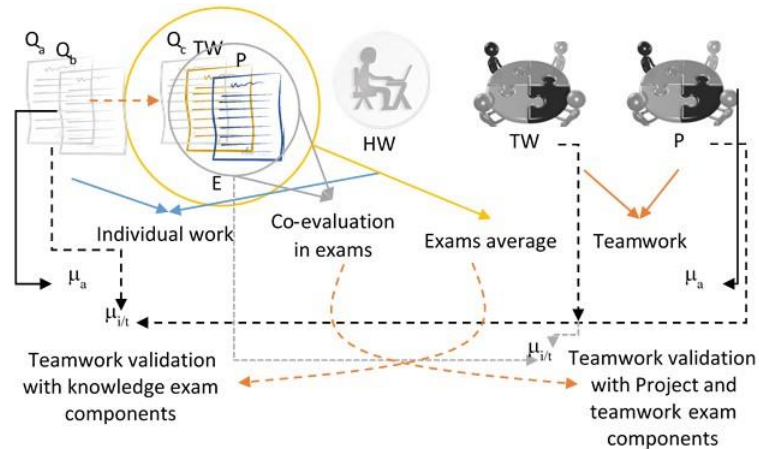

Figure 4: Relations between some statistics in the analysis with grades of activities.

Results

a) Scatter analysis for the individual discrimination in the team performance

Figure 5a shows the first paired comparison, teamwork (TW, P) versus challenge exam components (E: TW, P). There, each dot represents each student with a colour depending on their final grade in the course (Red: <70, fail; Yellow: between 70 and 85; Green: >85) and with a larger radius depending on the attending to face to face sessions. Figure 5b shows a similar comparison between teamwork (TW, P) and the quizzes average –and homework as minority- ($Q_{a,b,c}$, HW). Colour is as in Figure 5a and the radius represents the average number taking each Quiz/Exam ($Q_{a,b,c}$). In all cases, dotted lines mark the minimum pass grade.
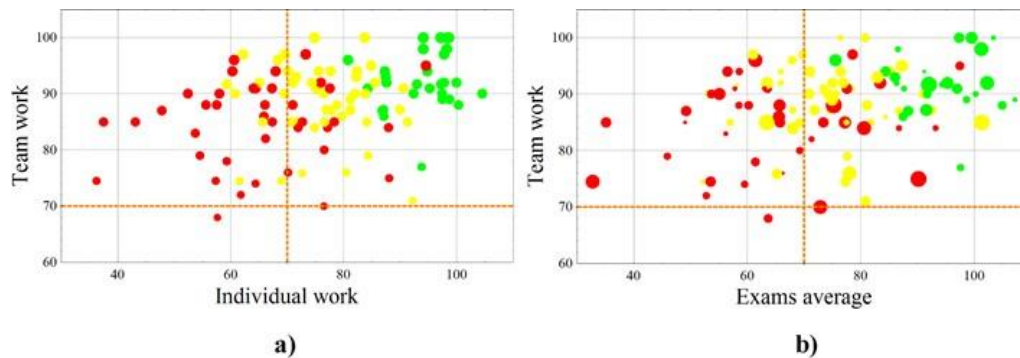

a)   b)

Figure 5: Dispersion plots comparing teamwork with: a) individual work, and b) exams average.

b) Descriptive crossed statistics between individual and team performance

There are two groups of estimators: quizzes and challenge activities. Table 1 exhibits the results. For the first group, based on Figure 4, μ_a and σ_a for Q_i are the average and standard deviation of the individual grades in such quiz ($Q_{i\,a,b,c}$). μ_n and σ_n are the statistics for times each quiz was taken. For the second group, μ_a and σ_a are the corresponding statistics for Teamwork and Project grade averages in each period, $SPOR_i$. While, $\mu_{i/t}$ and $\sigma_{i/t}$ are the statistics for the averages of relative grades of each group comparing individual and team performances as Figure 4 states.

Component/Project		μ_a	σ_a	μ_n	σ_n	$\mu_{i/t}$	$\sigma_{i/t}$
Quiz: basic knowledge	Q_1	73.2	25.9	2.0	0.8	0.8	0.3
	Q_2	72.3	23.4	2.0	0.8	0.8	0.3
	Q_3	71.2	28.2	1.9	0.8	0.8	0.4
	Q_4	68.1	23.8	2.0	0.8	0.7	0.3
	Q_5	71.2	28.4	1.9	0.8	0.8	0.3
	Q_6	72.8	26.3	1.9	0.8	0.8	0.3
Projects	$SPOR_1$	81.9	7.6			0.9	0.2
	$SPOR_2$	78.6	14.2			0.7	0.4
	$SPOR_3$	83.2	12.6			0.7	0.3

Table 1: Statistics and comparison among individual and teamwork Quiz and SPOR projects

Discussion

In the previous section several results comparing individual versus team performances as well as knowledge versus skills/competencies performance were presented based on a set of criteria defined by the author. Despite that grades for teamwork and projects are high graded in average, Figure 5a shows how TW and P components of exam E discriminates the individual performance. Attending was so uniform that it does not become meaningful. Figure 5b exhibit good discrimination between students failing or passing the course when they include components related to projects and teamwork activities.

Times that the quizzes were taken are not meaningful for the exam performance. Note that grades are in agreement in all figures for passing students.

The six quizzes in the whole course can be repeated two times and a third time just in the period exam as an optional component together with the project and teamwork parts. Table 1 shows each quiz is presented two times in average (μ_n), almost uniformly with large dispersion ($\sigma_n = 0.8$). Grades average is around about 70 (μ_a), while dispersions (σ_a) are mild. Statistics $\mu_{i/t}$ and $\sigma_{i/t}$ are the average and the standard deviation of the ratio between individual TW and P outcomes in the exam and team outcomes in their development. These results show this ratio is less than one in average, denoting an increased grade for failing students. This increasing is compensated with the individual results and more deeply with the knowledge co-evaluation in the exam (bottom of same $\mu_{i/t}$ columns). This analysis shows despite teamwork generates a shield for low performing students under teamwork, individual components (TW, P in E, and $Q_{a,b,c}$) discriminate effectively individual aspects of performance. Table 1 shows a mild higher performance in TW and P compared with $Q_{a,b,c}$. This behaviour is barely found in the scatter plot as a little shift to the left in the exams average (Figure 5b) with respect to individual work (Figure 5a). The shift average is 8.3 points with a dispersion of 3.2. Despite that criteria to evaluate TW and P are different to those for $Q_{a,b,c}$, it suggests that challenge activities performance is better than knowledge evaluation. More research based on more powerful indicators and larger groups is in order.

Conclusions

The use of technology has let a closer view of scientific and engineering problems and applications as an added value to the course presented. Abilities are enhanced and extended, because it summarizes previous knowledge into an applied approach. In the blended scheme, basic knowledge and research problem solving become complementary but not necessarily consequent. In addition, the challenge of measuring the learning beyond the content knowledge in the direction of skills appropriation and development of competences is a really complex task for teachers (Schwartz, 2014). Skills like critical thinking, problem-solving and collaboration require continuous practice while professional competences require several steps before to be owned superseding the course extent. Traditional evaluation is limited to measuring the dominion of contents, still with some uncertainty and not at the skilled level that each student will need.

Both, the outstanding students and those requiring support or alternatives to demonstrate competencies (more than the classical exam in the classroom), can be benefited with a flexible scheme of instruction. Thus, first group could finish some sections of instruction with a few efforts to concentrate in other themes or courses, while a second group can be evaluated more efficiently under more affordable schemes. Few times they have been effectively tried. In these schemes, several components of performance should be adequately combined instead of only added. Renewed schemes of instruction and education research should be running to get a better approach in terms of a more effective promotion and flexible combined schemes. Blended schemes, in the sense depicted here, should be experimented and improved currently to be disposable for the new generations. In a few years, possibly several courses should be evolved into MOOC, SOOC or MOOR schemes changing the traditional higher education as it has been known.

Acknowledgments

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'THE EMPATHY CHAIR' – THE JOURNEY TO OUR PERFORMANCE-BASED ASSESSMENT TOOL

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Abstract:

'The Empathy Chair' research project (2014-15) examined the use of role-play in assessing student empathy levels in a girls' primary school in Southern Ireland. Thirty one ten year-old students and I, the teacher researcher, worked for four months on a local history story to devise what culminated into a three-part or step self-assessment test of historical empathy. This paper seeks to describe the development of our 'Empathy Chair' assessment tool. Three steps evolved which enabled the students to self-assess their own levels of empathy towards a man 'John' who, in 1810, stole wet gunpowder from Ballincollig Gunpowder Mills and subsequently blew up three houses, killing twenty two people. Three forms of student expression, speaking, movement and writing emerged from students' responses. Data collection methods in this case-study included interviews, questionnaires and focus groups. Evidence pointed to improved levels of empathy, historical empathy and role-play and the establishment of a more caring classroom. Our test, incorporating History, Drama and assessment became a dynamic performance tool for our exploration of fictional aspects of a real man in a dilemma in Nov 3rd 1810.

Introduction

The objectives of this study were as follows: to establish the extent to which role-play could contribute to the assessment of student historical empathy; and second, to determine how 'The Empathy Chair' could meet the criteria of observation through role-play, informal observation, teacher manageability and assessment validity. This study looks at empathy in the teaching of History, historical empathy and its assessment, and Drama in the Irish primary classroom. Models of historical empathy are offered by Harris and Foreman-peck (2004). These assume that the teacher can differentiate between empathy as: a cognitive domain; a disposition or achievement; part of an ethic of caring; and historical empathy or empathy in the History classroom. Bryant and Clarke (2006) further distinguish between emotive and cognitive empathy found in History education. Rantala (2011, 59) recounts a model of assessment of historical empathy in Finland through 'creative writing and drama'. Cooper (2013) writes encouragingly about creative teaching of History. In the Irish History classroom, empathy or historical empathy is listed as a skill but studies on historical empathy are few.

> *Empathy involves the ability to appreciate how events in the past appeared to those living in the past. This is an abstract and difficult concept but it is important if we are to make fair assessments of the actions of people long ago*
> *(DES, History Teacher's Guidelines, 1999, 14)*

Drama became a discrete subject in Irish primary classrooms for the first time in 1999. Empathy is mentioned several times in the Drama Teachers' Guidelines (DES 1999, 5, 49, 50). However, it has never achieved any kind of embeddedness (Finneran, 2016). It is one of the two least taught subjects, and it is being taught less than the suggested one hour per week in classrooms (McCoy, Smyth, and Banks, 2012). A sense of role-play, central to this paper, has been derived from international authors (Baldwin 2004; O' Neill 1995; Woolland 1994). One interesting tool for assessing student empathy was devised by Berg et al (2011) which involves simulation. Similarly, our project is role-play based, starting as a drama exercise and evolving into a three-part self-assessment test.

Four assessment approaches are listed in the Irish History Curriculum Document (DES, 1999, 31) one of which is teacher observation. McNiff et al (2003,118) contend that all research begins with observation. Two Irish policy documents on assessment provided further information on observation: *Looking at our School: An aid to self-evaluation in primary schools',* (DES, Inspectorate, 2003, 26); A document, *Assessment in the Primary School Curriculum: Guidelines for Schools* was published by the National Council for Curriculum and Assessment or NCCA (DES, 2007). It reported that:

> *Teacher observation requires the teacher to listen and watch what a child says, does and more importantly how the child says and does. Observations can be immediate, spontaneous or planned, can happen any time, usually taking place over a short space of time. Much will go unwritten. It can be more effective if planned and recorded in a structured and focussed way* (46).

Poor teacher observation can result when the teacher: is unable to look beyond what is taught overtly (Cotton *et al.,* 2010, 463 – 467); shows a lack of 'sensitivity and commitment; listening is hurried (Even and Wallace 2010, 49); lacks familiarity with the subjective language of empathy (Rantala 2011); thresholds such as noise, space and group size (Heathcote in Johnson and O' Neill, 1984, 74) are low. Heathcote also lists other imperatives for teachers listening to role-play. She must pay attention for choice of words, tone, pitch and pause, a variety of registers…to capture mood, quality and type of tension. As we journeyed through the three steps, it became apparent that another layer of assessment, performance assessment, was fast becoming part of the identity of our test. Madaus and O' Dwyer (Stecher, 2010, 2) explain how performance assessment requires the student to 'construct an answer, produce a product or perform an activity'. It is live and it is immediate.

Storytelling

One of the skills listed in the History curriculum is '[E]mpathy' the capacity to: *'imagine and discuss the feelings and motives of people in the past'* and *'discuss how an event in the past may have been perceived by those who participated in it* (DES, History Curriculum Document, 1999). The first unit of work listed is 'Local studies' including 'Buildings …and industrial sites (e.g. factories, mills)'. The context here is a local gunpowder mills, (1794 – 1817), once the second largest provider of gunpowder to the British Army during the Napoleonic Wars. Built on the river and close to Cork harbour, the whole area comprised 1.76sq kilometres. 500 men and boys were employed at the mills. Trades included coopering, millwrights, carpentry. My curricular objective was to enable students to 'investigate … what it was like for people to live, work, worship or die in this place…stories of people who lived, worked, worshipped or died in this place' (DES, History Curriculum Document,1999, 45).

The second unit of the History curriculum is 'Story: Stories from the lives in the past'. An account of our story, 'John's story' is as follows:

> *On Saturday, November 3rd, 1810, twenty two people were killed and over forty injured when gunpowder stored in a labourer's house in Brandy Lane, Cork, exploded. A subsequent inquiry revealed that several employees of the Ballincollig Royal Gunpowder Mills (then the largest manufacturing in the world), had been systematically stealing he material which was sold on to quarrymen for rock blasting. Figures compiled by the Gunpowder Works authorities showed that almost half a ton was unaccounted for in a nine-month period preceding the disaster. During the course of the inquiry, it was discovered that the illicit gunpowder had to be dried when brought to the Brandy Lane house. The method chosen, somewhat unwisely on hindsight, was to use a lit candle. [ ] A disaster fund was opened for the victims and their dependents to which £12,000 was subscribed within two weeks.*
> *From 'A Dictionary of Irish History'* (Hickey, D.J. and Doherty, J.E. 1980, 96)

The project

      This practitioner research (Stenhouse 1975), single-bound case study (Yin 2009; Bassey, 1999) follows a constructivist, interpretivist paradigm. A mixed methods approach was adopted and data analysis was informed the writing of Miles, Huberman, and Saldaña (2014); and Cohen, Manion and Morrison 2011. I believe what was unusual about the test was that at the first two steps, students had to perform (live) a task in front of their peers. There was no ready-made list of answers:

Step 1. Speaking-in-role:
Teacher and students set up an imaginary scenario. Someone sat silently in the chair in role as a character in a dilemma. Students in role as empathisers stood and spoke to the character, advising him, questioning him. Some or all quietly addressed the chair, making notes of what they said or about to say. Teacher made brief notes. The atmosphere in the room was hushed as if a live performance was in progress.

Step 2. Move! Move! Move!:
Students revealed their empathy level by standing near or far from the chair as if in a walking debate. Here the hypothetical statement was 'I empathise with the character'. They struck a pose showing their positive or negative reaction to the seated character. Next, the teacher called out in-role sentences from Step 1.This enabled the students to reconsider their viewpoint and move to another position.

Step 3. Writing-in-role:
Students redrafted what they initially wrote / spoke. This could be in letter format to the chair. Two or three sentences sufficed. Writing was displayed on the walls or on the floor.

Project criteria

Criterion 1. Is the *Empathy Chair* a role-play based observation tool?

      The test only works if students are prepared to go into role. Often, I was surprised at who excelled at maintaining a role. At one lesson, we agreed that John's mother and daughter survived. Step 1 of the test required me to listen to the students speak in role as the daughter. I jotted down in-role statements by some students:

> *Rose: I don't want to be poor but not if this is what we have to do for money.*
> *Aban: I will never forgive you for this. You are a shame to your village.*
> *Sarah: What you did was the wrong thing to do. I wish you could understand.*
> *Kate: I don't want any money if it involves stealing.*
> *Daro: Why Dad, why did you steal the gunpowder?*

Daro was an introverted student who indicated to me that for her, surprisingly, going in role was an enjoyable experience. She had spoken at more length than normal and more lyrically so. The class teacher commented '*Now. Now. There you go. (Daro) pulled it off. Normally she is very quiet*'. This became evident in Step 2. I noticed that she stood beside the student in role as John and her face showed sadness and upset. In Step 3, Daro's in-role writing was:

> *Why Dad, why did you steal the gunpowder. I know you wanted the best for me but stealing wasn't the way to go. You should have told me you were running low on money and we could've sorted this out together. I am disappointed in you for stealing but you are forgiven.*

Daro is an example of a phenomenon where, in my experience, 'quieter' students fare (speaking, moving and writing) just as well if not better than more outgoing students do. In other words, this live performance test can 'throw up' surprises. It is for all. IT has something for everybody.

The second in-role task- 'Move! Move! Move!' proved to be the most interesting part of the test to observe. When I called out sentences I had noted from Step 1, many students now physically changed positions like moving figures on a chess board. I framed them in role as a relative at times and at other time they were themselves. I was fascinated observing students struggle with their empathy levels. You could not fail the test but the students needed to be explain why they did not feel historical empathy. One student commented '*If I was moving and I saw my friend move somewhere else, I would follow her so I'm not the odd one out*'. I took the in-role test myself and found it to be 'hard work'. It required inner listening. It felt organic. We had to re-negotiate the rules of this step. Shifting the rules was endemic to our 'Empathy Test'' which led to a greater sense of ownership and student voice.

Criterion 2. Is the Empathy Chair an informal test?

The History Teacher Guidelines (DES, 1999, 32) state that manageability is a factor in the selection of teacher assessment methods and 'much of the information gleaned through the teacher's observations will not be written down' (116). Our test was easy to set up, no textbooks or resources required, quick to administer, no more than 15 minutes. I didn't feel the need to write any comments, scores, evaluations. Mostly I listened. I felt relaxed. However, I believe these classroom management issues such as noise and furniture re-arranging could deter a teacher from trying this test.

'Teacher observation, spontaneous or planned, can happen at any time.' (NCCA Guidelines (2007, 38). On May 21st, the students sat their annual national, standardised numeracy test. Their comparisons between this test and the Empathy test indicated that the Empathy test is informal. When I asked the class teacher to comment on the formal or informal nature of our test she said:

> '*Oh I assume it's informal. It's very flexible. At the drop of a hat and what I like about it is I could see myself doing it with the class novel. Link it in, that's the best way to go. Its all about time, isn't it. Time is everything*'

Central to this test is the students' ability to partake in informal, improvised role-play. The students compared their formal class play with this informal kind of improvised drama. There were no lines to be learnt, only lines to be invented, independently. The test seemed to nurture spontaneity and invention. One day, another teacher (interested in drama) entered the room for a few moments. Spontaneously, she said 'I'd say there's a lot of independent thinking going on there. No wrong or right answers here.' They continued quietly with performing the test as the visitor sat down to observe. Informal drama, informal observation, historical empathy emerged as we explored the story from our local mills. John's story became a powerful hook for student learning.

Criterion 3a. Is the Empathy Chair test a valid test?

Indicator 1: The student must accept and believe in the fiction.

These students had some experience of role-play. A new student, Student A, with limited English had joined the class in January. She experienced difficulty understanding the story and accepting the fiction. I spoke to her about this. She said:

> Student A: I don't like doing 'Hello I'm Mary. This is happened to
>   Me. (We are doing) Ha Ha Ha all the time.
> Teacher researcher: Is it drama we do in the hotchair?
> Student A: Yes because, for example, when ('Joanna') was in the chair she
>   was doing another act like Cinderella but in the Powder Mills.

Her expectations of role-play were different. Also, her limited spoken English seemed to inhibit her. I spoke to the teacher about this EAL student. Should I remind the student that she could opt out of the research project? The teacher advised me to read Student A's writing. I was moved by the poignancy when she wrote in role as John's daughter. She seemed to accept process and express the fiction in an unexpected way:

> *'All of the days I cry because my Dada because he almost kill me and I don't think he love me…*
> *He died in his own accident'*

Indicator 2: The 'Empathy Test' is live. The teacher must be willing to take the risks.

On June 5th, (popular) student C sat in the chair in role as Napoleon who had survived the lost war. The other students cast themselves in role as Josephine. Suddenly, student C started to laugh uncontrollably and said:

> How many wives have you, anyway? Ha. Ha. I need new jeans. I can't talk to you now.

I was surprised that she had 'burst the bubble' for the others. These mini-bombshells can happen during role-play, due to nervousness, in a way that could generally not happen in another subject. It may deter another teacher from using the 'Empathy Chair'.

One day towards the end of the project, the students were framed as poor French peasants. However, the quality of the role-play was poor. We spoke of 'register' and accent. I was nervous of accents as they sometimes make students laugh. However, accents were used to differentiate the peasants from Josephine. It worked really well. Unfortunately, there were noise issues as they began to shout in unison at Napoleon in the correct register. The class teacher spoke up. We stopped the lesson temporarily. We discovered that peasants could not empathise with the nobility (Napoleon) even if Napoleon showed remorse. The status gap is too wide. Then, nervously, I asked what the seated character to tell us how she felt when the peasants kept their distance from her, she replied 'Offended. Offended'. She gave herself full marks. Unexpectedly, the second 'Napoleon' wanted her say and asked me afterwards to read her writing-in-role which I did, aloud to the class:

> *'I am truly ashamed and I mean it. All those peasants out there are sick and now they're worse*
> *than ever cos I lost the war and I wish I could afford to make the peasants feel more empathetic*
> *for me. I'm truly sorry for France.'*

There was a sense of immediacy which may unnerve some teachers. However, the word 'immediacy' features in the NCCA (2007, 46) and both History curriculums (1999a 79; 1999b, 115). The 'Empathy Test' was immediate, intimate and alive. Sometimes, I felt as if I was a voyeur in a medical case conference on some medical patient. I felt there was a ring of truth about the role-play.

Indicator 3: The student needs sufficient background information.

For this role-play test to work best, the students need sufficient background knowledge. On one occasion, Co-researcher 1 said '*You don't give all the information like about Napoleon. They need more information.*' Chastened by this, I adopted strategies from Stanisalvski (Benedetti, 1989) in teaching student actors. These included established considerably more facts at the start of the study. Also, the school principal led an enjoyable trip to the Gunpowder Mills. We also familiarised ourselves with the 1901 set of rules pertaining to the behaviour of the workers. These three new sources of information proved pivotal for in-role work by the students. A transcription of Co-researcher 1's final comment showed the difference this new information made:

'Well, it made sense at the end. With the new facts we go backwards and forwards like to the past and go to now pretty nifty. That was good. And when you get to go to the mills, you go back to the people in the history you find out more about the history in the people like where they worked in the mill. They get to have fun too in the test. They get to act and everything. John? I was thinking about John. We know he broke the rules when he stole the gunpowder to feed his family. We know the rules. I don't know did he forget. But he put the gunpowder to dry by the fire. He should have known better.'

Results, discussion and conclusions

There were three principal gains in this research. Firstly, the 'Empathy Chair' test as an enabling test of student empathy was valued. Second, there was a sense that students and teachers felt more connected to this local history story. Third, I discovered that the best way to facilitate historical empathy was through research and framing the class as empathisers – a mother, a daughter, a son, a friend, a neighbour. It can be argued that role-play can contribute to the growth of the History skill, 'working as an historian'. There were limitations to this study. First, the study was a small scale case study and project findings were inconclusive. Second, the students had previous experience of Drama not representative of the national 'norm'. Third, the research was conducted in a girls' school with few discipline issues. A fourth limitation was that there were not more collaborators or beneficiaries in the project. Fifth, another teacher could dismiss a test that a child 'can't fail'. Sixth, this test based on role-play may not appeal to all teachers.

In future studies, it would be useful to explore characterisation, a more evolved form of role-play, listed in the Drama curriculum. Future studies could usefully explore the extent to which students identify their preferred approaches in the Drama curriculum in the context of teaching middle and senior History classes. On the negative side, it is doubtful that teachers would consider using three approaches when observing learning.

In conclusion, opportunities for the assessment of historical empathy through role-play need specific facilitation at initial teacher education and at in-service level. Empathy can be understood as a continual refinement in the caring classroom between pedagogic literacy between History and Drama. No great resources are needed. If, as educators, we are required to empower our students to see someone's view, we must create new tasks that will require pupils to analyse, explain, describe, and empathise. The 'Empathy Chair' test within this study of local history, gave us a sense of those people, even if by 'virtual' experience, who worked and died in the Ballincollig Gunpowder Mills all those years ago. This performance assessment tool is unique. It required these primary students to perform several tasks requiring historical empathy. We breathed life into 'John', a man in a dilemma all those years ago.

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DEVELOPMENT OF FOUR GENRES OF AUGMENTED REALITY GAMES FOR ENGLISH LEARNING

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Abstract

Few studies have discussed overcoming learning difficulties for children in non-English speaking countries by increasing their learning motivation. Therefore, this study developed four genres of augmented reality English learning games comprising word matching, listening, question & answer, and scenario question to enhance the level of fun. An Aladdin story from a sixth grade English lesson was used to provide interactive game materials to convey the target learning content. The developed games can be played on a tablet to provide a greater sense of three-dimensionality and interactivity. A total of 75 sixth-grade students were recruited as the research participants for 4-week experiment. Findings showed that the girls' satisfaction with the 3D images, interface design and operation functions in Q & A game was significantly higher than the boys' satisfaction was. The result found that the girls' satisfaction with the interface design in listening game was significantly higher than the boys' satisfaction was. The educational applications of the English teaching methods developed in this study can be extended to other elementary schools in Taiwan. Additionally, future studies should investigate the sequential development of interactive augmented reality English learning materials applicable from the third to sixth grades.

Introduction

According to Vogel et al. (2006), teaching through the use of interactive simulations and games improves learning and shapes better learning attitudes than the use of conventional teaching methods; this is regardless of age, gender, or circumstances. When choosing media, major considerations include the teaching content, student needs, and the desired learning effectiveness (Moore & Kearsley, 1996). Augmented reality (AR) includes real and virtual space and connects the two using interactive devices (Wang et al., 2014). Oliver and Herrington (2001) indicated that interactive digital storytelling technology is already being paired with various types of media, such as AR and virtual reality (VR). The advantage to using this technology is that it can effectively pass information to the reader. The use of tablet computers is quickly becoming a teaching trend. As tablet computers can be operated intuitively by touch, they are easier to use than desktop or laptop computers (Chen et al., 2012). Research regarding the use of and motivation behind computer games indicates that gender is a significant background variable (Griffiths, 1997; Olson et al., 2007; Young, 2000). We therefore designed four different types of AR games for tablet computers based on sixth grade English teaching materials. We then analyzed how gender differences influenced student reactions to 3D images, interface designs, operation functions, and level of fun as perceived by the user.

Application of augmented reality (AR)

Input and output equipment is needed to complete an AR display. A computer identifies tag locations and shows animations or images that have been prepared in advance. The AR tags can be in color or in black and white for the computer to recognize them easily. The computer analyzes images received from a camera to display corresponding virtual objects and animations in 3D (Liarokapis, 2007). These change with the viewing angle of the user. Users can move the tags to change the locations of the virtual objects on the screen, thereby achieving human-computer interaction. As Figure 1, AR was appropriate to learn solar system because we are unable to universe and interactivity of AR attracted students' curiosity and interest (Shelton and Hedley, 2002).
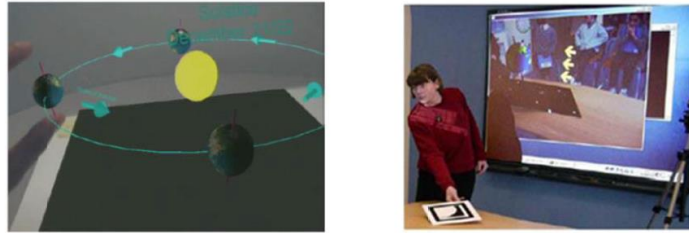
Figure 1 Teaching about the planets using AR (Source: Shelton & Hedley, 2002)

Elements of AR game design

By literature review, the essential elements of AR games in this study are: 3D image, interface design, and operation method. Azuma (1997) mentioned that AR must (1) combine the real and the virtual, (2) be interactive in real time, and (3) register in 3-D. It is a technique that merges images of the real environment with virtual computer images, thereby creating another reality in the virtual medium and enabling users to see and operate virtual 3D objects in their actual surroundings (Chen, 2007). Ingredients of AR are graphics, sound, interface, and gameplay (Howland, 1998). Graphics files should be the same size and present a consistent style, and sounds give the player hints about what may soon occur in the game. The interface should be designed based on user characteristics in addition to being easy to understand and use. Gameplay emphasizes challenge and fun. Integration techniques enable users to engage in real-time interactions with the 3D environment. A 3D environment can achieve better effects than simple 2D displays or played videos. There are many options when it comes to methods of game operation: action/arcade, adventure, scenario question, simulation, strategy, puzzle, Q & Azes, somatosensory games, and touch games (DeMaria & Wilson, 2003; Gee, 2003; Shih, 2012; Sun, 2013; Mortara et al., 2014).

Research methods

Development of four AR games

We designed four different types of interactive games including word matching, listening, Q & Azes, and scenario question. These are shown in Table 1. The games were based on lesson three of the sixth grade English curriculum. Lesson 3's theme was: Where Are You Going?

Table 1 Categories, definitions, 3D images, operation methods, and screenshots of the four games

Type of game	3D image	Operation method	Screenshot
Word matching	A 3D town with a 3D animation of two virtual characters running	The computer screen displays a 3D town with two characters waiting for a question. Suppose the quest is "Where is the bank?" The student must select the bank in the town, and the two characters will run to bank, thereby answering the question. If an incorrec building is selected, then the characters will remain where they are.	
Listening	3D objects or buildings	The computer says a word, and the student must select the correct picture and word cards. If the answer is correct, the screen will display a 3D image and play a sound effect indicating a correct answer.	

Question and answer (Q & A)	3D characters	The student first picks a question card, then the computer will read the question for the student to answer. If the answer is correct, the screen will display a 3D image of the correct answer.	
Scenario question	Aladdin and uncle, market, and cave	As the tablet PC is moved, the student can see various things with Aladdin. When a narrative dialogue ends, a multiple choice problem appears. The student must choose the correct answer based on the story he or she has just seen.	

Experiment

The games were tested at Shin-Chuang Elementary School in New Taipei City and Cishan Elementary School in Kaohsiung City from April 24 to May 26 in 2014 in accordance with their English curricula. The participants comprised a total of 75 sixth graders, who used the tablet computers in pairs. Participants played the game for one hour each week during the experiment for a total of four hours. The participants filled out a questionnaire after game play. A teaching assistant first explained how to operate the AR game on the tablet computer before the students were allowed to operate and practice on their own. The procedure was as shown in Figure 2.

Figure 2 -Teaching assistant explaining how to operate the AR game on the tablet computer

Results and discussion

The objective of this study was to examine gender preferences regarding 3D images, interface design, operation functions, and perceived level of fun for the four types of games developed in this study. A total of 75 valid questionnaires were recovered, with 34 from male students and 41 from female students. The results of a qualitative and quantitative analysis are as follows.

3D images

The results regarding the 3D images for Game 1, the word matching game, are shown in Table 3 (t=2.01, p>.01). The female students did express a slightly higher degree of satisfaction with the 3D images in Game 1 than the male students (M=4.55 and M=4.16, respectively), but the difference was not statistically significant. The gender difference regarding the 3D images in Game 2, the listening game, also was not significant (t=1.97, p>.01), though the girls again expressed a slightly higher degree of satisfaction with the 3D images in Game 2 than the boys (M=4.59 and M=4.20, respectively). The gender differences regarding opinion of the 3D images in Game 3, the Q & A game, were significant (t=2.74, p<.01). The girls expressed a higher degree of satisfaction with the 3D images in Game 3 than the boys (M=4.62 and M=4.07, respectively). The gender difference regarding opinions of the 3D images in Game 4, the scenario question game, was not significant (t=1.03, p>.01). The girls again expressed a slightly higher degree of satisfaction with the 3D images in Game 4 than the boys (M=4.55 and M=4.38, respectively).

Table 3 Analysis of gender differences in opinions of 3D images

Dimension	Group	Mean (*M*)	Standard Deviation(*SD*)	*t*	Significance (*p*)
Game 1	Male	4.16	.96	2.01	
Word matching	Female	4.55	.67		
Game 2	Male	4.20	1.02	1.97	
Listening	Female	4.59	.58		
Game 3	Male	4.07	1.00	2.74*	*p*<.01
Q & A	Female	4.62	.64		
Game 4	Male	4.38	.72	1.03	
Scenario question	Female	4.55	.72		

Note: *: *p*<.05

Interface design

As shown in Table 4, there were no significant gender differences regarding opinions of the interface design of Game 1 (*t*=.86, *p*>.01). The girls expressed a slightly higher degree of satisfaction with the interface design in Game 1 than the boys (*M*=4.59 and *M*=4.45, respectively). There was a significant gender difference regarding opinions of the interface design of Game 2 (*t*=2.42, *p*<.01). The girls again expressed a higher degree of satisfaction with the interface design in Game 2 than the boys (*M*=4.73 and *M*=4.32, respectively). There was a significant gender difference in opinions regarding the interface design of Game 3 (*t*=2.15, *p*<.01). The girls again expressed a higher degree of satisfaction with the interface design in Game 3 than the boys (*M*=4.58 and *M*=4.15, respectively). Finally, there were no significant gender differences regarding opinions of the interface design in Game 4 (*t*=1.33, *p*>.01). The girls again expressed a higher degree of satisfaction with the interface design in Game 4 than the boys (*M*=4.68 and *M*=4.46, respectively).

Table 4 Analysis of gender differences in opinions of interface design

Dimension	Group	Mean (*M*)	Standard Deviation (*SD*)	*t*	Significance (*p*)
Game 1	Male	4.45	.73	.86	
Word matching	Female	4.59	.68		
Game 2	Male	4.32	.86	2.42*	*p*<.05
Listening	Female	4.73	.53		
Game 3	Male	4.15	.97	2.15*	*p*<.01
Q & A	Female	4.58	.68		
Game 4	Male	4.46	.80	1.33	
Scenario question	Female	4.68	.58		

Note: *: *p*<.05

Operation functions

As shown in Table 5, the gender differences in opinion regarding the operation functions in Game 1 were not significant (*t*=.82, *p*>.01), though the girls expressed a slightly higher degree of satisfaction with the operation functions in Game 1 than the boys (*M*=4.40 and *M*=4.28, respectively). The gender differences in opinions regarding the operation functions of Game 2 also were not significant (*t*=2.00, *p*>.01), though the girls again expressed a slightly higher degree of satisfaction with the operation functions in Game 2 than the boys (*M*=4.52 and *M*=4.16, respectively). The gender differences in opinions regarding the operation functions in Game 3 were significant (*t*=3.17, *p*<.01), with the girls expressing a higher degree of satisfaction with the operation functions in Game 3 than the boys (*M*=4.59 and *M*=4.03, respectively). Finally, the gender differences in opinions regarding the operation functions of Game 4 were not significant (*t*=1.36, *p*>.01), though the girls again expressed a slightly higher degree of satisfaction with the operation functions in Game 4 than the boys (*M*=4.68 and *M*=4.30, respectively).

Table 5 Analysis of gender differences in opinions of operation functions

Dimension	Group	Mean (*M*)	Standard Deviation (*SD*)	*t*	Significance (*p*)
Game 1	Male	4.28	.73	.82	
Word matching	Female	4.40	.63		
Game 2	Male	4.16	.86	2.00	
Listening	Female	4.52	.69		
Game 3	Male	4.03	.89	3.17*	*p*<.01
Q & A	Female	4.59	.55		
Game 4	Male	4.30	.92	1.36	
Scenario question	Female	4.68	.58		

Note: *: *p*<.05

Four games comparison

Table 6 reveals how it works regarding the development of four genres of AR games for English learning. Results show in Table 6. Table 6 indicates that Q & A game reaches the significant differences in 3D images, interface design and operation functions. Listening game is also significantly different in interface design. In general the girls' satisfaction was significantly higher than the boy's satisfaction was.

Table 6 Analysis on 3D images, interface design, operation functions in four games

	3D images	Interface design	Operation functions
1 Word matching			
2 Listening		*	
3 Q & A	*	*	*
4 Scenario question			

Gender differences

We then conducted further investigation into the reasons for the significant gender differences in opinion of the 3D images, interface designs, and operation functions in the Q & A game as Table 7. Girls felt more satisfactory than boys in listening game and Q & A game shown in Table 8. For 3D images, the significant differences were the results of 3D dimension and visual richness according to interview. For interface designs, the significant differences were the effects of sound and interaction. For operation functions, boys felt Q & A was too difficult to manipulate.

Table 7 Overall satisfactions of male and female students regarding the four games

Dimension	Group	Mean (*M*)	Standard Deviation (*SD*)	*t*	Significance (*p*)
Game 1	Male	4.24	.73	1.29	
Word matching	Female	4.45	.55		
Game 2	Male	4.19	.87	2.25*	*p*<.05
Listening	Female	4.58	.54		
Game 3	Male	4.10	.91	2.70*	*p*<.01
Q & A	Female	4.58	.53		
Game 4	Male	4.37	.78	1.22	
Scenario question	Female	4.57	.62		

Note: * *p*<.05

As shown in Table 8, the gender differences in opinions regarding the level of fun in Game 1 were not significant (t=.53, p>.01). The girls again expressed a slightly higher degree of satisfaction with how fun Game 1 was when compared with the boys (M=4.20 and M=4.08, respectively). The gender differences regarding opinions of level of fun in Game 2 were not significant (t=1.99, p>.01). The girls again expressed a slightly higher degree of satisfaction with the level of fun in Game 2 than did the boys (M=4.49 and M=4.09, respectively). The gender differences regarding opinions of the level of fun in Game 3 were not significant (t=1.72, p>.01). The girls again expressed a slightly higher degree of

satisfaction with the level of fun in Game 3 than did the boys (*M*=4.54 and *M*=4.15, respectively). Finally, the gender differences in opinions regarding the level of fun in Game 4 were not significant (*t*=.73, *p*>.01). Again, the girls expressed a higher degree of satisfaction with the level of fun in Game 4 than did the boys (*M*=4.51 and *M*=4.35, respectively).

Table 8 Analysis of gender differences in opinions regarding level of fun

Dimension	Group	Mean (*M*)	Standard Deviation (*SD*)	*t*	Significance (*p*)
Game 1	Male	4.09	1.00	.53	
Word matching	Female	4.20	.75		
Game 2	Male	4.09	1.00	1.99	
Listening	Female	4.49	.746		
Game 3	Male	4.15	1.19	1.72	
Q & A	Female	4.54	.64		
Game 4	Male	4.35	1.04	.73	
Scenario question	Female	4.51	.84		

Note: *: *p*<.05

Conclusion

The contributions of this study lie in part in the development of unique games which enabled the teachers to teach in a more diverse and interesting way and students to learn in an entertaining and educational environment. The complete documentation of this study provides teachers with future reference for designing relevant teaching materials. Based on interviews with the teachers and participants, we present the following suggestions regarding AR games:

(1). The 3D animation in the scenario question game gave users a view of everything from the ground to the inside of the cave. This received considerable praise. Thus, designers can use 3D AR projections and variable viewing angles to design characters, scenes and games to merge virtual objects and reality (Azuma, 1997).

(2). Many of the students in this study favored the scenario question game because the 3D animation was fun and interesting and because there were also multiple choice problems that enabled them to review what they had learned. In contrast, the other games focused on either gameplay or learning. Thus, a good teaching game should enable students to play and learn at the same time (Prensky, 2001, 2003; Kirriemuir & McFarlane, 2004).

(3). Different interactive methods or gestures can be used for the operation of games, or different levels in clearance conditions can be adopted for the gaming mechanisms so as make the game feel more challenging or fresh.

This study included quantifiable statistics and open-ended questionnaires, but was still inadequate in terms of depth. We suggest that future studies use qualitative research methods such as in-depth interviews and participant observation to more comprehensively investigate and interpret how students feel about game-based learning and how they can be motivated to learn. Finally, in terms of teaching material design, more refined images might do more to attract the attention of the students. Creativity should go into gameplay design so interactive games can be differentiated from educational games, thereby establishing market segmentation, and gaining the favor of more teachers or students (Lee & Hao, 2015). The games in this study were operated via buttons on computers or the iPad mini tablet. Designers might try other methods, such as making use of the gyroscope in the iPad mini so that game control can be achieved by moving and turning the tables. Future studies might also develop somatosensory games with wearable devices or other operation methods.

Acknowledgments

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MOOCS: PROBLEMS AND CHALLENGES IN HIGHER EDUCATION

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Abstract

Massive Open Online Courses have developed into an alternative form of Higher Education, with the result that, at the current time, various universities are adopting such educational strategy. This is due to their eagerness to accommodate the educational demands of the masses and to achieve internationalization and visibility before the world, or simply as an effective business model. This comes in spite of the fact that the quality of content, methodology, evaluation, learning results, lack of feedback and credibility of such courses, among other things, has been called into question.   This research paper is the result of an analysis of diverse bibliographic sources concerning the development of MOOCs, and the participative experiences on various courses of the major MOOC platforms, with the aim of demonstrating the principal problems and challenges of MOOCs and how these could be overcome from a teaching, technological and organizational perspective; in such a way that in the future, this teaching modality could contribute to and strengthen this form of inclusive education.

Keywords: *MOOC, learning analytics, data mining, digital literacy, virtual teaching learning environments.*

Introduction

In today's society, knowledge is marked by the necessity of permanent learning, in the context of a growing demand with more and more people applying for education, including Higher Education (HE). Current capabilities of HE institutions are not enough, not only due to physical or technical limitations, but because in many countries education is far away from the potential students' possibilities: i.e. access to an HE institution is too expensive, or they are in other countries, or they have to work for their family or support themselves.

Virtual Education is among the possible solutions, supported by the wide spread of Information and Communication Technologies (ICT). Among many existing applications of ICT in Education, there are several labeled as emergent, due to their recent development and innovative character; one of these are Massive Open Online Courses (MOOCs).

MOOCs are special examples of virtual teaching learning environments (VTLEs), where the distinctive characteristic is massiveness. In their brief history, they were first received as a powerful means for solving educational needs; later on, after many unsuccessful experiences, a great number of students dropped out of the courses, leading to disappointment. Currently, despite the persisting deficiencies, HE institutions are promoting new course offers in almost every field of knowledge; mostly using platforms like Coursera, edX, and Miriadax.

The objective of this work is to analyze different bibliographical resources about the development of MOOCs and experiences in observing several of those courses; with the purpose of exposing our points of view, regarding the way some problems can be overcome from a pedagogical, technological and

organizational perspective. This may contribute to expanding inclusive learning in countries where it is strongly needed, like in Ecuador.

Development

The methods and study materials employed in this work were a combination of bibliographic methods, by means of specialized searches referring to the development of MOOCs, from scientific journals of an investigative nature, and diverse digital databases ProQuest, Scopus, Ebsco, Gale Cengace: (among others). Also from blogs, audiovisual documents and other web based resources, with the aim of forming a bibliographic repository, which would lead to an analysis and to synthesize in a reflexive and systematic manner; later on employing logical-historical methods and analysis methods to reveal the characteristics and development of MOOCs. Case studies identify problems which were later confirmed by the deliberate participation in various MOOC courses from different platforms, (Coursera, Edx , MiriadaX, Udacity, Udemy, Openlearning); and finally, based on the problems encountered, various strategic points were suggested for the improvement of MOOCs.

In the exhaustive analysis of the path which MOOCs have taken, it was observed that this phenomenon, from the outset, has generated controversy. On the one hand are the defenders of MOOCs who claim that this type of learning dramatically transformed Higher Education and those MOOCs and make a significant contribution the field of education (Daniel, Cano, and Gisbert, 2015). It is also claimed that MOOCs are a revolution which has great potential within the world of education (Bouchard, 2011; Aguaded, Vázquez-Cano, and Sevillano, 2013). Nevertheless MOOCs have not achieved the objectives for which they were created, nor had the desired impact. The other side argues that MOOCs should be seen as a futile experience (Guthrie, 2013). An expert in e-learning, Albert Sangrá, pointed out that MOOCs work very well as a marketing tool for universities to gain visibility in a world market, without any disruption to learning.

But what are MOOCs and how are they characterized? Many researchers state that MOOCs are part of the evolution of e-learning, a category of online course, open and participative distance learning courses which all people can access and participate in via a computer with an internet connection (McAuley, Siemens, Cormier and Steward, 2010). To date their definition is not clearly standardized further than the characteristics associated with the term MOOC (Massive open Online Course): Massive, implying that there are no limits on the number of participants, open in the sense that any person can register for free, open content i.e. fermium model (Prieto, 2007). Their online character implies that these courses are distributed via the internet and course means that they must have a coherent structure, learning objectives and program content which allows for goals to be reached and learning achieved. However, many MOOCs do not currently fulfill these characteristics as the following epigraphs illustrates.

Based on the distinction of MOOCs established by Stephen Downes, one of the co-founders of these courses, there is a significant difference between xMOOCs and cMOOCs. Leaving aside the other classifications currently found in the realm of MOOCs, (SMOOC, DMOOC, iMOOC, BMOOC, etc.), we see that the great majority of MOOC platforms, be they in the private or academic sector, offer traditional courses (xMOOC) with a conductive focus which has been put up on a MOOC platform; and are taught by respected professors from prestigious universities, such as the courses offered by Coursera, edX, Canvas, Udacity, and MiradaX among others, and argues the quality of these courses to the prestige of the great universities, but not to the learning results students, instructional design, content quality and more. Concerning cMOOCs (connectivist MOOCs), based in social constructivism, students reach agreements about the knowledge generated via communicative action (Downes, 2014); in other words through social learning, autonomy and collaboration (principles of connectivism). However, this collaborative learning does not take into account the manner in which effective collaborative work groups can be formed online (Brindley and Walti, 2009).

Through the diverse participation in Coursera courses (Powerful Tools for Teaching and Learning: Web 2.0 Tools, English Composition I), edX (Enhancing teacher education through OER: Tess-India, Principles of Written English), FutureLearn (Get Started with Online Learning, Web Science), MiriadaX (New scenarios in digital learning), Udacity (Educational Technology) and Openlearning (Into the Future With MOOCs), it can be proven that the courses provided are effectively traditionalist in nature and in some cases with de-contextualized content and extensive videos. Meanwhile, in the courses offered by the Openlearning, Udacity and FutureLearn platforms, the contents are limited to a set of videos and presentations. In other words these simply appear to be repositories for content, whose materials can easily be found in YouTube channels and which really do not promote active learning. This is in accordance with the position of many critics of the courses who claim that MOOCs only deal with technology (having only digital content) and that they provide a low quality form of instruction (Margaryan, Bianco and Littlejohn, 2015). We believe that the low quality of the instructional design is due to the fact that, from their beginnings, the courses do not adhere to a specific methodology with regard to the teaching/learning process which entails a critical and reflexive analysis of the students. Furthermore, there is a lack of balance between the pedagogic, technological and organizational aspects that the very nature of MOOCs demands.

As such, many scientific studies reveal that MOOCs, from their outset, have been plagued by criticism and a questioning of their quality, evaluation methods, credibility, lack of interaction, motivation and feedback among other elements. As many scientific studies have observed, we agree that these problems are largely due to the mass nature of MOOCs. It is impossible to conceive of how one, two, five or more tutors can be expected to attend to hundreds and even thousands of students, when within more traditional teaching methods it is accepted that it is difficult to attend to the learning needs of a group of thirty or forty students.

Regarding the problem of the credibility of MOOCs, the aspects of evaluation and attaining official certification are open to plagiarism and fraud. Very few MOOC platforms have incorporated mechanisms to verify the authenticity of their participants. This process usually takes place at a later date when payment is made for course certification. Coursera employs a technological tool named Signature Track (Coursera, 2013), whereby with each evaluation this application is activated which permits the verification of the identity of the participant by taking a photograph of them with a webcam and registering a typing pattern. EdX uses software called Verified Certificate (edX, 2014) to evaluate photographs of the student during the course, using a webcam and information released by the government.

A further point is that the vast majority of evaluations take the form of multiple choice which do not drive the student to make a critical or reflexive evaluation; similarly with partner evaluations where there are no mechanisms for verifying that partners evaluate each other in a fair and correct manner despite the fact that some platforms employ rubrics for this purpose.

Evidently the principal problem faced by MOOCs is the high drop-out rate of students before course completion. The result has been a low rate of students who complete courses, believed to be between 5 and 15% according to early investigations (Jordan et al., 2013); and at the current time there appear to be very few statistics regarding completion rates. In addition it has been shown that these courses face problems of a sociological nature, with regard to the lack of interaction between students and students and teachers, whereby students do not receive help with doubts or questions put forward in discussion forums; the students feeling abandoned in this dehumanizing education process.

Against this backdrop George Siemens and Stephen Downes, creators of MOOCs, point out that this type of learning has lost touch with the original aims. The original idea of MOOCs has been changing due to

the fact that MOOCs do not strictly adhere to their original characteristics. In this way we find various MOOCs demand payment for recognition (Coursera, EdX, futureLearn, MiriadaX) or a monthly subscription fee (Threehouse). As such, many MOOCs are not free-access or of an open nature. Furthermore there are platforms such as Udacity whose materials are not open to be re-used and their courses also carry a cost.

Nevertheless, despite these issues MOOCs have greatly diversified and there are a great number of MOOCs in almost all areas of knowledge; and they form part of the academic portfolio of many universities worldwide which have adopted these courses as an academic strategy with several aims: that of meeting the demands of huge quantities of students, gaining visibility in a world market, in-sourcing and in some cases as a business model and in this way demonstrating the reasons stated by (Hollands y Thirtali, 2014): extend the reach of the institution and access to education, create and maintain a brand, improve the economy via the reduction of costs or the increase of profits, improve academic results for both the MOOC participants and the current students, innovate the teaching and learning process and to carry out research into teaching and learning.

Leaving aside the problems which have blighted MOOCs from the outset, there are suggestions for a need to overcome their main deficiencies, particularly with regard to their results. There is the potential for a solution to the problems which would contribute to the development of Higher Education (Bates 2014). In that, it is necessary to strengthen and re-build these virtual learning environments with a pedagogical, technological and organizational vision; in such a way as to avoid failure, to improve rates of course completion and attain a globalization of knowledge. In this way MOOCs will help to satisfy the demands of society in the 21st Century; where active, creative and reflexive learning is needed within an open and collaborative environment, rich in tools and technologies and multimedia content to allow participants to develop, apply and practice skills, and achieve significant learning results. For these reasons we believe it is necessary that MOOCs conform to certain characteristics, adopt strategies for digital learning and incorporate more technological tools:

- Improve the course completion rates of students, through motivation and retention of participants; using technology such as artificial intelligence, learning analytics, data mining and web semantics among others. Also take into account that the educational innovation and success of MOOCs is not solely guaranteed by technology; but that they also require active intervention by the educator (Alonso and Gallego, 2010).
- Adhere strictly to the characteristics of MOOCs (Massive, Open, Online and Course). In other words allow open and free access to the entire course, learning materials and open model in such a way as to re-orient MOOCs to the original ideals with which they were created; i.e. promote the students development via an open and transparent learning platform, as indicated by the creators of MOOCs (Siemens and Downes).
- Define and develop metrics to validate the quality of massive online courses, taking into consideration characteristics necessary for effective learning. For example, according to Conole (2013), effective learning can be achieved by: incentives for reflection, facilitating dialogue, promoting collaboration, applying theory learned in a practical way, permitting creativity and motivating students.
- Develop teaching methodologies for virtual environments, taking into account the 'massive' factor, and which aim for a significant learning which is active, critical, reflexive and collaborative; where students value the application of participative and dynamic methods with the use of diverse possibilities provided by ICT in educational contexts (Sáez and Ruiz, 2012).
- Design interactive content which is motivating and in context, using simulation systems as an example gammigication, augmented reality, 3D, telepresence and mobile technology in such a way that the student is challenged to overcome obstacles and solve problems.

- Incorporate automatic tools for follow up and monitoring of massive groups of students in such a way that when the student needs help or has doubts the tutor receives an alert in their e-mail inbox or an instant messages to their smartphones and can thus attend to the needs of the student at the correct time. The students do not therefore feel abandoned. Systems need to be implemented so that tutors can offer help and orientate students at the appropriate time like those implemented by various institutions. An example is Moocsmentor which manages the participation of users of the platforms of the universities of Harvard, Berkley and Stanford.

- Develop evaluations which are not limited to a simple multiple choice test, but which take into account essays and practical exercises which oblige the student to develop critical and reflexive thinking. Open Response Assessments (ORAs) could be a great contribution to MOOCs as they facilitate feedback. Currently one platform, edX, has incorporated such a tool. In addition it is important to think of mechanisms to authenticate work to avoid possible fraud.

- Educate institutions in the skills necessary to use the tools based in the ICT, with the aim of being able to design innovative and creative educational materials which will promote a dynamic, reflexive and motivational learning experience. This also requires a reconceptualization of the role of the teacher who becomes a facilitator or mediator of knowledge.

- Educate students so that they gain the skills needed to use ICT (social interaction technology), with the aim of: sharing information with the community, writing skills, creative and critical thinking, organizational skills, problem solving and ethical responsibilities.

Conclusions

Technological advances have resulted in a journey towards a digital world, where MOOCs have emerged with the purpose of providing massive access to knowledge; feeding the growing demand for Higher Education, an objective which to date has not been fully achieved. Nevertheless, MOOCs, despite their problems, represent an alternative form of education. It is therefore necessary to re-think MOOCs from a pedagogical, technological and organizational viewpoint.

The digital literacy of tutors and students is key for participation on MOOCs, with the aim that these participants acquire digital, social and organizational competence. Furthermore MOOCs need to be incorporated within the formal learning sphere, thus enriching this mode of education.

Undoubtedly technological tools such as data sourcing, learning analysis and web semantics combined with artificial intelligence would help MOOCs, above all, to overcome the problems that they currently face with regard to interaction and feedback.

It is necessary to further develop definitions of methodologies for the process of teaching and learning in virtual environments; taking into consideration the 'massive' characteristic of MOOCs, an aspect which itself generates problems.

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COLLABORATION BETWEEN A RESEARCH METHODOLOGY COURSE AND EFL PRACTICE TEACHING

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Abstract

In this article we present an initiative in which two compulsory courses- Research Methodology and EFL Practice Teaching – were partially blended in a Teacher Education College. The methodology courses (i.e. Quantitative and Qualitative Research Methods) are courses in which students study topics as data collection and data analysis, while Practice Teaching is a pedagogic workshop which accompanies the students' teaching at school. The purpose of this collaboration is twofold: to create a relevant and positive research arena for the methodology courses on the one hand, and to promote critical and reflective teaching skills and thinking of student-teachers, on the other. In order to evaluate our collaboration an action research was conducted on 8 English student-teachers who took part in the Practice Teaching course. Findings are that the students repeatedly related to research concepts when referring to student learning. The interviewed students characterized various aspects of learning, mentioning a variety of tools used for collecting empirical information. Thus, the learning and understanding of statistics was enhanced when students conducted their own research using real data and addressing real problems. We therefore propose to use Practice Teaching course as an arena for application of other courses taught at the college (e.g. psychology, philosophy and language) so data collected about teaching and learning could serve as a basis to deal with various authentic issues.

Introduction

In this article we will present an initiative in which two courses- Research Methodology and EFL Practice Teaching – were partially blended in a Teacher Education College. Hereafter are short descriptions of the two courses.

Introductory research methodology courses (i.e. quantitative and qualitative research methods) are compulsory courses in undergraduate teacher education programs in many countries. In these courses, students study topics such as data collection (via observations, interviews, questionnaires, etc.) and data analysis (e.g. descriptive statistics, basic statistical tests, content analysis). The objectives of these courses are to promote the use of academic literature and to support inquiry skills.

Practice teaching is a course which incorporates teaching in practice school and pedagogic workshops within the college. It is concerned with developing practical knowledge and skills in teaching EFL. Student-teachers integrate and apply theoretical knowledge and methodologies acquired in different courses in the college as well as develop reflective skills upon teaching. They observe classes and teach students at the Junior-High/High School grade level. In addition, they learn about school life and daily practices. Among course objectives are: acquiring practical teaching experience, developing teaching skills including a variety of teaching techniques in the heterogeneous classroom, becoming familiar with the students' learning styles, developing practical skills and strategies for teaching EFL and developing awareness of their skills as teachers. During the practice teaching they plan lessons, teach them and observe lessons taught by peers. They give and receive feedback via self-reflection, peer-assessment and feedback provided by the master teacher and the pedagogical advisor. Also, they keep a reflective journal (blog), where they post at least once a week. The blog's objective is twofold: the student-teachers practice authentic writing on a weekly basis and as a result develop their writing skills; in addition, through

reflecting on their experiences they develop awareness regarding their teaching. Moreover, the student-teachers are required to develop a project, taught and assessed within the course, which is a culmination of their three years of studies at the college. Within this project, student-teachers choose a relevant topic, design lesson plans which include innovative pedagogies, and then assess various effect of their teaching as knowledge, skills, and attitudes that their pupils developed while working on the project.

Research Methodology and Practice Teaching are taught as two separate compulsory courses in which a group of students participated in both courses. In this collaborative venture, each teacher focused on her expertise, but the courses' assignments and requisites were shared. The purpose of this collaboration is twofold: to create a relevant, authentic and positive research arena for the Research Methodology courses on the one hand, and to promote critical and reflective teaching skills and thinking of student-teachers, on the other. Even though both courses are compulsory courses in the teacher education college, the attempt to combine between the two is unique.

Literature Review

Both courses have some problematic issues. Statistics courses are compulsory in many academic departments. Students, mainly from the Social Studies, tend to have negative attitudes towards these courses and may experience difficulties, tension and anxiety (Balouglu, Deniz, & Kesici, 2011; Murtonen & Lehtinen, 2003; Onwuegbuzie & Wilson, 2003). In some cases students end these courses with more positive attitudes (Ball & Pelco, 2005; Gilat, 2004; Sunzuma, Zezekwa, & Bhukuvhani, 2012), nevertheless they have difficulties applying their content in their work and do not see their relevance to teaching (Gardner & Hudson, 1999; Gilat, 2004). It is therefore recommended that students participate in authentic research activities so they see both the relevancy of the content and options for future integration in their teaching (Fong et .al., 1986; Moore, 1997).

One of the objectives of Practice Teaching is for students to develop reflective and critical skills. The development of these skills helps them to become more autonomous and aware of their teaching practices while taking into consideration pupils' need and learning processes. Yet, students' reflective thinking tend to be uncritical and concentrate mostly on their own activities and not on learning processes. In order to close the gap, Lougrhran (2004) proposes to adopt "a student-teacher as researcher stance" in which students accept more responsibility for their learning about teaching. As a result, they will be encouraged to cope with their personal concerns in their teaching in general and in their practice teaching in particular. This is consistent with Heaton's (2000) encouragement for future teachers to constantly investigate what they need to know. In other words, student-teachers should be encouraged to develop understanding about their own teaching practices through collecting data from various sources, analyzing them and then conceptualizing into meaningful reflections. These findings parallel Hammerness, et al. (2005) argument that reflecting on what their students are learning rather than on their own teaching practices (knowledge, skills and attitudes/dispositions) will cause teachers to become lifelong learners. Development of "metacognitive habits of mind" can lead to continual teacher's improvement, adaptation and lifelong learning.

Description of the Initiative

Thus, two major problems arise from the literature with regards to the two courses - research methodology courses are considered as irrelevant by students, and the students' reflections are shallow and not meaningful. Therefore, we suggested an innovative approach which addressed these two issues. In this initiative, the students had to apply the topics studied in the statistical courses to evaluate various activities in their practice teaching while focusing on their project "The Effects of ICT (Information Communication Technology) on Various Language Skills". The project dealt with the topic of Leadership, which was a yearly topic suggested by the Ministry of Education.

The students engaged in one of several projects: they were required to study the effects of writing a class WIKI on the development of students' writing skills; the effects of preparing an electronic poster on the development of their high-order thinking skills; and the effects of producing a short clip on their development of oral skills. In all cases the student attitudes towards learning English was studied along with their acquisition of language skills.

In the framework of research methods course the students had to define various learning variables such as motivation, attitudes knowledge and skills. In the framework of the quantitative research course the student-teachers designed research tools such as questionnaires and tests to examine changes in the variables and in the qualitative research course the students conducted interviews, performed observations and analyzed resources (notebooks, tests) in order to achieve holistic conception of the learning/teaching phenomenon.

Data collection by the student-teachers included: collecting and evaluating pupils' work samples (pre-and-posttests); performing and analyzing class observations; conducting interviews and questionnaires. In addition, they wrote reflective blog post each time they observed and/or taught lessons. The pedagogical advisor offered constructive comments and questions which invited students to carry out new reflections and analysis in order to promote their reflective skills.

Evaluation of the Initiative

In order to evaluate our collaboration we conducted an action research in which we wanted to understand whether it helps to overcome the problems previously mentioned (irrelevance of statistics and shallow reflections). First, we assumed that the students react more positively to research if the concepts are placed in an applied context. The connection between theory and practice allowed for more meaningful research opportunities and contexts. Our second assumption was that students' reflections would focus not only on their teaching practices (as they tended to do in previous years), but rather on their students (what their students are learning and how they are performing) and what they, as teachers, can do about it.

Eight third year students (native speakers of Arabic and Hebrew) majoring in English and pursuing their teacher training certificate took part in the Practice Teaching course. Six of them took both courses (Research Methods and Practice Teaching) during the same academic year, while two other students studied Research Methods during the previous academic year and took Practice Teaching with no relation to Research Methods course.

Data Collection and Analysis

We checked the advantages and disadvantages of collaboration between the two courses based on two variables- knowledge and students' satisfaction. We conducted in-depth interviews with all the students who took the Practice Teaching course to evaluate how they use methodological knowledge to relate to the learning processes and to express their opinions about the collaboration between the two courses. The students were asked to express their opinions on the relevance of the two courses to their teaching and the connection they identify between the two. Also, the student-teachers were asked to apply the knowledge taught in both courses by writing evaluation criteria for pupils' performance in different skills (reading, writing, oral, listening, high order thinking skills). In addition, students were asked to relate to the concepts and tools they acquired in Research Methods which they find useful in their practice teaching.
In addition, we also analyzed students' blogs (reflective journals) to see if they referred both to their teaching and to the students' learning, attitudes, etc.

The student-teachers interviews were recorded and transcribed and thereafter the transcriptions and the

texts from the reflective blogs were divided into units of meaning and analyzed by the writers of this manuscript using content analysis technique by categorizing various aspects of research questions, such as knowledge of concepts and tools, attitudes towards the integration (advantages, disadvantages), etc.

Results

The results presented are categorized into two groups. The first will relate to student-teachers knowledge of research method components with relation to students learning. The second relates to student-teachers attitudes towards our initiative of combining the two courses.

Knowledge

One of the categories we were interested in was students' knowledge of concepts and tools and their implementation in teaching EFL. Based on content analysis of the interviews, there is evidence that they do use research method tools in their teaching and in their reflections on teaching processes. Thus, when asked "What research components can you apply in your future career as a teacher?", they related to various variables as achievements, learning and attitudes and referred to the meaning of different statistical measures. For example, one of the student-teachers reported: "When I become a teacher I will pass questionnaires on knowledge as well as on students' attitudes. I will not only look at my students' grades. I will not only check averages but look at differences in students' scores and standard deviations in order to understand what's going on in my class". Another student claimed that she "... learnt that if there is a problem in a class, I will check articles on the topic and will see what I can learn from them". Another example that implies a connection is when a student-teacher says: " In order to make sure that my teaching goals are achieved, I will observe the students and make pre-and post-tests and not only refer to normative tests. I also developed technical skills in Excel to calculate different variables."

Analysing the blogs we realized that student-teachers related not only to their teaching activities (which was a characteristic of their first blog entries and in former years), but also they related to pupils' reactions, comments and learning processes. For instance, some of the student-teachers mentioned that they changed their lesson plans based on their observations of the pupils. For example, she noticed that "the pupils were asking many questions about directions, so the next lesson was changed to a mini-geography lesson". Another student posted that based on student observation she began questioning the effectively of her teaching method and the asked: "Do you understand the text well, or would you prefer me to explain it differently the text next time?" Students referred to feedback that they got from various sources - observations, tests, talks, etc.

In other words, student-teachers view research tools as a means to monitor and understand their students' learning processes in addition to their own reflections on their teaching processes.

Attitude towards the Integration

Another category that we checked in our Action Research was student-teachers' satisfaction from the integration of the two courses - how they found the integration relevant to their future careers, what they considered as advantages and disadvantages of the integration, etc.

The six students who took the two courses during the same academic year reported that for them the connection between the two courses is natural. Thus, one of them stated: "I am all for the connection between the courses, there is no reason to separate between them - you check research variables as you do the practice teaching". Another student saw the integration between the courses as obvious: "Both courses seem like one course".

Two students who didn't take both courses during the same academic year, on the other hand, related to disadvantages between the two courses: "I don't see any advantage in combining the two courses. I think there shouldn't be any connection - it only confuses me even more".

Summary of Results

After investigating the advantages and disadvantages of collaboration between the two courses based on two research questions via analyzing in-depth interviews with the students and their reflective journals (blogs) we saw that students repeatedly related to research methods concepts when referring to student learning. The interviewed student-teachers characterized various aspects of learning (achievements, motivation, attitudes, behaviors) mentioning a variety of tools used for collecting empirical information. Moreover, they reported transformations in their teaching and provided a new perspective on practices they had been conducting in the past. The whole process led them to a deeper understanding not only of their teaching, but also of students' learning, thus reinforcing our perception of the potential of the contribution of the methodological training to the didactic studies. Since we did not compare the group to "a control" group, this change could be attributed to the student-teacher natural professional development and maturation during their training, yet this pattern was more evident during the collaboration and was more prominent with the six students who studied the two courses than with the two who studied the Research Method course in a previous year who related mainly to student achievement on tests in the interviews to their teaching in the blog.

The student-teachers were also satisfied with the integration as the majority of them mentioned mutual contribution of the courses and found it difficult to separate between them. Similarly to our finding regarding the use of concepts, the two students who did not study both courses in the same academic year were of the idea that the research courses are not related in any way to their teaching training program. This could be due to the fact that the concepts were taught in isolation.

Discussion and Implications

The goal of this collaboration was to create relevance in learning the methodology in authentic research arena and at the same time to promote future teachers' development of learning and research skills, critical thinking and lifelong learning. We believe the initiative was a success.
The findings of our action research reinforced the idea of importance of collaboration between Practice Teaching and Research Methodology courses and exemplified the potential of methodological training as part of didactic studies.

Results show that learning and understanding of statistics was enhanced when students conducted their own research using real data and addressing real problems. These findings are supported by Benson and Blackman (2003) who pointed out those positive attitudes to research methods can result from successful adoption of active learning methods. Also we found that methodological knowledge, as well as statistical investigation, serve as tools that can help the student-teachers understand their own teaching processes more deeply and critically, as well as their students' learning. Promoting inquiry skills as a means for professional development is consistent with various writers and researchers (e.g. Dewey, 1938; Hammerness et al., 2005; Heaton, 2000; Loughran, 2004) who view successful teachers as lifelong learners. They claim that teachers who are continuously involved in inquiry tend to shift the focus from a teacher centered to a learner centered approach, from teaching to learning.

In spite of the fact that our action research provides evidence that both- student-teachers and their students benefited from the collaboration, we are undecided how to develop and strengthen this learning initiative so that systematic reflection on learning will be a natural part of practice teaching, how to encourage student-teachers to learn about their own teaching practices , how to develop student-teachers' reflective

and metacognitive skill to further enrich thinking and development and how to encourage students to become "critical colleagues" by enhancing their abilities through structured feedback.

We propose to use Practice Teaching course, in general, and the third year project, in particular, not only as an arena for application of research, but also for application of other courses taught at the college (for example courses dealing with psychology, philosophy and with language learning). Thus, data collected about teaching, learning and learners could serve as a basis to reflect and deal with various issues as teenage behaviour, teaching ideology, foreign language learning, etc.. Consequently, the Practice Teaching course will be the central point where the learning at the college (pedagogy, didactics, methodology and disciplinary studies) is applied to teaching and/or to reflection on teaching and learning. This could also result in a more holistic perception of the training processes by the student-teachers.

Since the administrative structure of the college does not enable us to "break barriers" between courses and disciplines, we recommend using reflective journals as a basis for an active dialogue with a number of lecturers asking questions that raise issues studied in the various courses. Documentation of behaviors, knowledge, attitudes and perceptions using qualitative and quantitative research tool can serve as a basis for discussion. Such discussions should be conducted not only between the student-teachers and their lecturers but also with peers. For example, working in pairs (critical colleagues) could become a critical yet comfortable arena for reflective practice. As more issues are incorporated into the student-teachers practices, a future cycle of action research should be conducted to evaluate the changes.

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AWARENESS OF UAE UNIVERSITY CHEMICAL ENGINEERING STUDENTS ON ABET ACCREDITATION

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Abstract

It is very important that engineering students are to be well-aware with the ABET accreditation process including its a-k outcomes presented to them at the beginning of the courses. Therefore, the objective of this current study is to conduct a comprehensive survey among the chemical engineering students of UAE university to determine their familiarity with a-k outcomes and their significance in ABET accreditation. Moreover, students' knowledge about the benefit of obtaining their degrees from an ABET accredited program will also be analyzed. At the end of survey, the participants are asked to suggest what are the means by which students' awareness on ABET accreditation process can be increased towards their graduation. The results of the survey reveal that UAE university chemical engineering students are somewhat less-aware of the ABET outcomes; ABET accreditation and its benefit towards their career. In addition, it clearly shows that workshops, seminars and chemical society activities on ABET accreditation would definitely increase the awareness among the students.

Keywords: ABET a-k outcomes, course syllabi, engineering students

Introduction

In order for a standardized curriculum and teaching of engineering worldwide, a reliable accreditation such as ABET (Accreditation Board for Engineering and Technology) is of great importance. Accreditation can be defined as a process for evaluating an educational institution or program to see if it meets specified standards of educational quality. Its purpose is to ensure that the prospective students graduating from an accredited institution or program have achieved at least minimum competency required in their chosen fields of study (Prados et al. 2005).

However, until the early 20th century, very few efforts were put into standardizing the engineering programs (Prados et al. 2005; Culver et al. 2005). In fact, it was in 1922 that the formal accreditation of an engineering program was undertaken by American Institute of Chemical Engineers (AIChE), which developed a recommended chemical engineering curriculum structure. They managed to establish a committee to evaluate chemical engineering programs and to publish a list of those institutions whose programs satisfied the recommended criteria (Prados et al. 2005).

ABET has certain criteria that are required for the accreditation for an institution to be accredited and comprises a total of eight of them including: (1) Students, (2) Program Educational Objectives, (3) Student Outcomes, (4) Continues Improvement, (5) Curriculum, (6) Faculty, (7) Facilities, (8) Institutional Support. It is the responsibility of the program seeking accreditation to demonstrate effectively that their particular programs meet these criteria (Anon 2014). The accreditation criteria used to evaluate all American engineering programs since 2001 have been discussed extensively since they were first introduced in 1996. Among the ABET criteria is the students (criterion 1) which is the crucial element in the accreditation process and represents the focal point of this study.

The College of Engineering at the United Arab Emirates University (UAEU) was inaugurated in 1980 and comprises of the academic departments including Architectural Engineering, Chemical Engineering, Civil Engineering, Communication Engineering, Electrical Engineering, Mechanical Engineering, and Petroleum Engineering. All programs offered in the college were first accredited in 1998 and since then have been involved in ongoing accreditation visits and revision cycles (Mourad & Selim 2010).

Assessment of the student outcomes (3a-3k) have been thoroughly discussed in the literature (Felder & Brent 2003); however implementing it to equip students with these specific outcomes is clearly lacking and hence needs greater attention. In view of the above, this paper aims to obtain information quantitatively through a thorough questionnaire about the students' awareness towards the ABET accreditation.

Methodology

A comprehensive survey has been developed by the authors to assess the awareness of ABET accreditation and criterion familiarity amongst the chemical engineering students in the UAE University. The designed survey included general information on ABET such as general concept, specific ABET criterion, program outcomes and the advantage of having an accredited degree. As part of the department's continuous effort in improving the chemical engineering program offered at UAE University, the authors aim to equip its students with a better knowledge of ABET. The questionnaire was distributed to all levels of chemical engineering students. The study population involved 50 students (20 males and 30 females).

Results and Discussion

The survey was designed to mainly evaluate the general knowledge that current chemical engineering students have regarding ABET, their outlook on the different course outcomes and relying on their feedback for further improvement into the awareness. The questions (1 to 5) were aimed to measure the basic awareness of ABET, such as knowing the role of the accreditation and its merits. The response to the first question is presented in Fig. 1 and although the 26% of students had heard of ABET since they joined the university, there was also a considerable 20% of students who just learned about ABET through this survey. This response itself is a useful indicator to show that although there is some awareness, much more improvement is required. Moreover, 56% of the students indicated that they were aware of what ABET stands for (Fig. 2) which clearly indicates that at a department that has been accredited by ABET, much more than half of the student body must be aware of this important recognition. In the similar context, survey by Mourad et al. (Mourad & Selim 2010) at the mechanical engineering department in UAE University revealed that almost 68% of the students were not aware of ABET.

A favorable response was received when students were asked about the home country of ABET (Fig. 3), as 74% of them answered correctly by selecting USA; as compared to a previous study at the same institution where the correct response was selected by only 53% of the students (Mourad & Selim 2010). However, about 62% (Fig. 4) of students indicated that they did know about the main responsibility of the ABET committee, which can be translated as a strong motivation for further efforts by the faculty members of the department and the college itself to provide students more information about the program they are studying in.
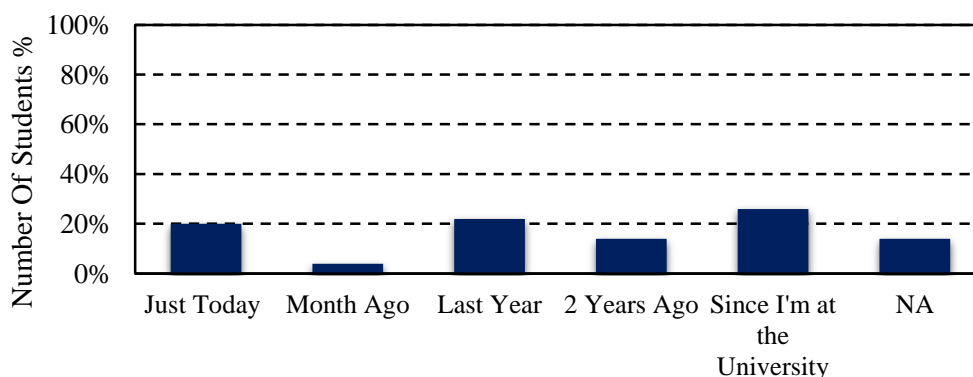
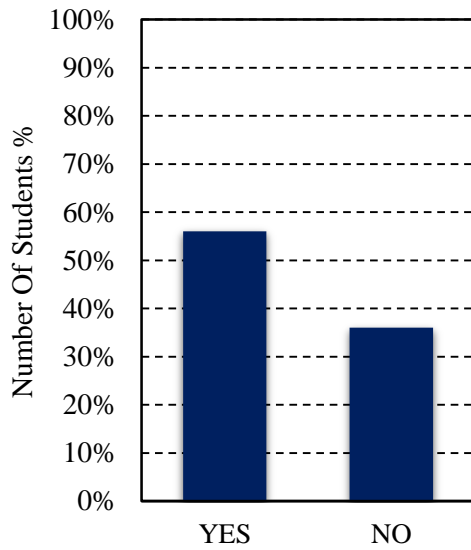**Figure 1.** Response to: When was the first time you heard about ABET?

Figure 2. Response to: Do you know what ABET stands for?
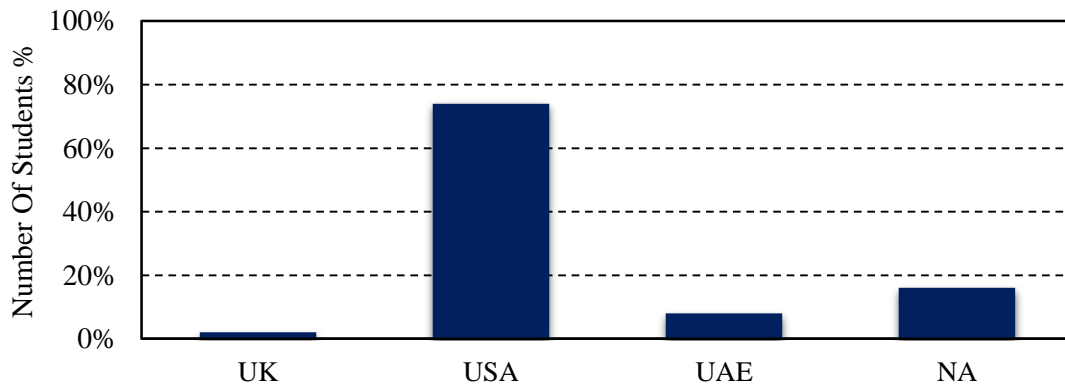

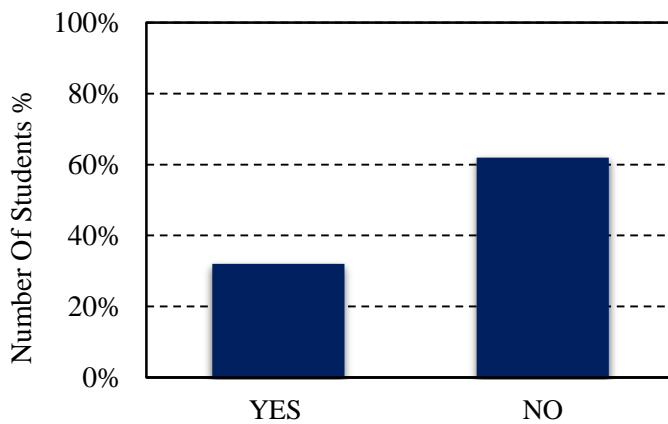**Figure 3**. Response to: The home country of ABET organization is?

Figure 4- Response to: Do you know about the main job of ABET organization?

It has been discussed in the literature (Sala et al. 2011; Culver et al. 2005; Mourad & Selim 2010) that incorporating an understanding of ABET criterion along with the study material not only helps students achieve more academically, but also fosters growth professionally elsewhere. In line with the above statement, students were asked if they were aware of any benefits that they have if their department is accredited by ABET, the response of which is presented in Fig. 5, majority of participants (70%) indicated they did not know. The revised ABET criteria (Anon 2014) encompasses all major aspects of student development into an engineering and technology program by providing coherent curricula that are designed to meet the professional goals of students. Students of the chemical engineering department at UAE University were also asked if they ever met with a ABET representative, the responses according to Fig. 6, show that 72% had not met any ABET representative in any of their campus visit. This is another pointer that could be improved when future ABET visits would be arranged for the department.
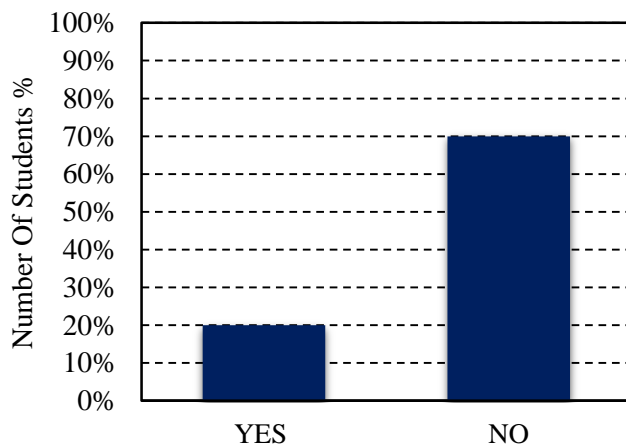

Figure 5- Response to: Do you know any example of student's benefit if his/her department gets accredited by ABET?
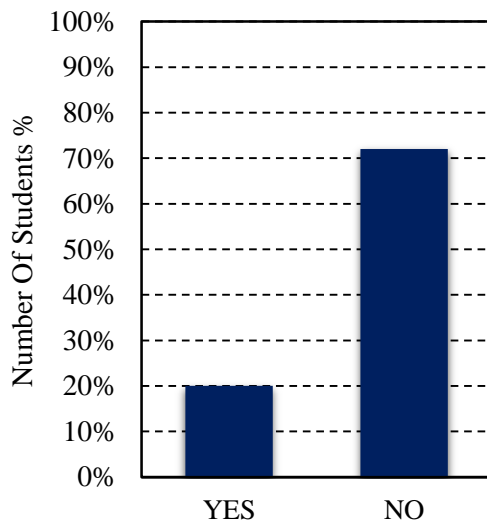

Figure 6- Response to: Have you met with the ABET representative in their last visit?

It is common knowledge that ABET consists of eight criteria, where criteria 1 and 2 deal with students and program educational objectives, respectively, while the third criteria, student outcomes, commonly referred to as "a-k" that outlines the scope of outcomes the student must achieve at the end of their studies

(Anon 2014). Students in this survey were asked about their awareness of the specific outcomes they need to have by the end of their studies, each of the 3a-3k criteria was assessed according to three responses: (a) very much aware (b) some (c) not aware. These are presented as graphs in Figs. 7 (a)-(c). Among these results, it was interesting to find that most students in the first response 'very well aware' responded well to outcomes d, f and g in which 84%, 74% and 74% students responded, respectively. On the other hand, lowest response amongst Fig. 7 (a) was for criteria j with a response of 36%. Moreover, about 46% was the highest response for criteria c and h for which the students choose 'some' as their answer; lastly, it was found that very few students were unaware of the program objectives, highest students (8%) responded to outcome j. Overall it can be inferred that most students have knowledge of the different criterion, however, more conclusive results could be obtained when students are more familiar with these terms in practice.
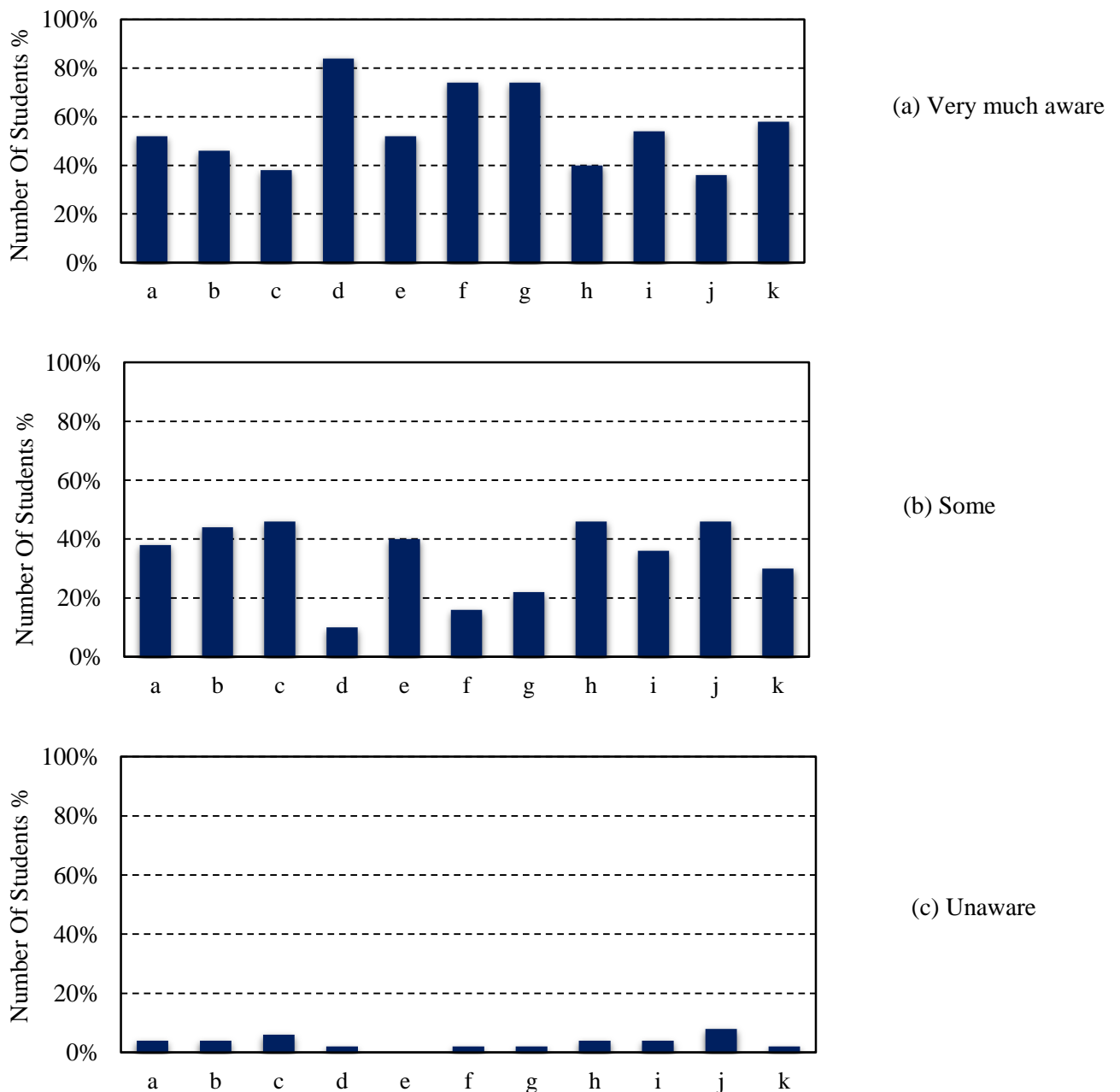

(a) Very much aware

(b) Some

(c) Unaware

Figure 7- Response to: Are you AWARE of the following ABET outcomes you should have by the time of your graduation?

The last portion of the survey aimed to receive some feedback on the type of activities that can be held to promote awareness of the ABET accreditation so that the students may fully make the best out of their program. Options (a)-(f) as seen in the survey (*see Methodology*) were given and their responses are shown in Figure 8. About 68% and 66% students responded that the awareness on ABET can be improved by attending ABET workshops and participating in ABET activities respectively.
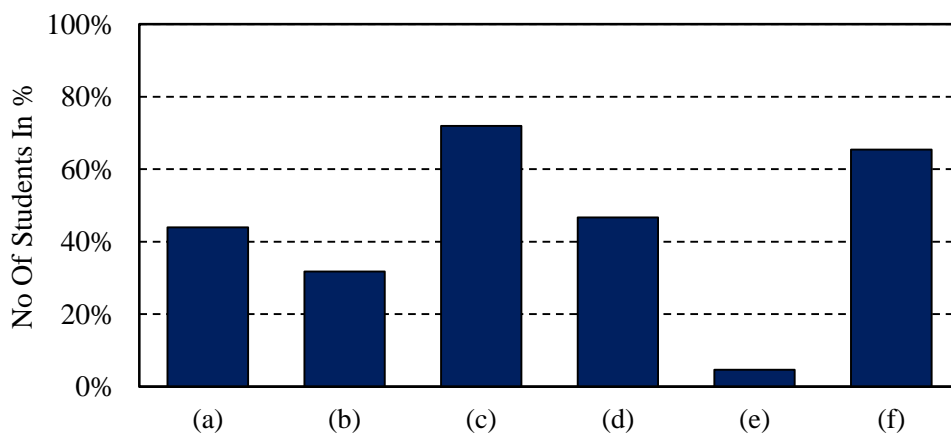

Figure 8- Response to: From the following, choose three options that could be helpful in improving students' awareness about ABET accreditation? (a) Attending lectures on ABET (b) Brochures (c) Attending ABET activities (d) Through Chemical Society activities (e) Highlighting a-k into the exam questions (f) Attending workshops on ABET

Conclusion

In the present study, students of the Chemical Engineering Department at UAE University participated in a survey that aimed to gain information regarding their knowledge about the ABET accreditation, its benefits and expected outcomes. The data was collected based on their responses on the questionnaire and was presented to give an overview of the results. An ABET accreditation is not only central to the department but also essential for students so they can take the full advantage of the different resources for their long term career development. The results of this survey indicated that students were not very much aware of the role of ABET in accrediting their degree programs, therefore, recommendations such as more involvement in ABET workshops and activities and understanding the specific outcomes in their coursework will allow students to better understand the accreditation process.

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LAGRANGE MULTIPLIER AND PENALTY FUNCTION METHODS EMBEDDED IN CONJUGATE GRADIENT METHOD FOR CONSTRAINED OPTIMIZATION PROBLEMS IN ENGINEERING

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Abstract

Lagrange Multiplier Method and Penalty Function Method are classical methods designed to solve equality and inequality constrained optimization problems in Engineering, Economics and Management Sciences. Conjugate Gradient Method is a more advanced and a more accurate Method developed to solve this class of problems. In this paper, we have developed a scheme that combines the Lagrange Multiplier and the Penalty Function Methods to solve this class of problems that often emanates mainly in Engineering. One advantage of this new scheme is that it circumvents some of the difficulties involved in the execution of the Multiplier Method and the Penalty Method. When the scheme was applied to some test problems in Engineering, the results obtained were found to compare favourably with the analytical solutions and sometimes better than what was obtained using the Lagrange Multiplier Method and the Penalty Function Method.

Keywords: *Conjugate Gradient Method, Penalty Function Method, Lagrange Multiplier Method.*

1.0 Introduction

In Engineering, Management sciences and many other fields, some problems arise which may be minimization of man power, the time taken for a particular experiment to take place, wear and tear of a machine, minimizing the cost of maintenance or maximizing the performance of a machine or profit making in a particular firm to mention but a few. Translating all these into a mathematical model leads to the general minimization problem that we shall examine in this paper. The basic problem to be considered in this paper is the minimization of a function subject to equality and inequality constraints of the form:

$$Minimize\ f(\boldsymbol{X}) \tag{1.1a}$$

$$Subject\ to:\ g_i(\boldsymbol{X}) \leq 0,\ i = 1,\ 2,\ \dots,\ n \tag{1.1b}$$

$$h_j(\boldsymbol{X}) = 0,\ j = 1,\ 2,\ \dots,\ m \tag{1.1c}$$

where $\boldsymbol{X}$ is a vector in n variables, $f(\boldsymbol{X})$ is the objective function to be minimized, $g_i(\boldsymbol{X})$, a set of inequality constraints and $h_j(\boldsymbol{X})$, a set of equality constraints which are twice differentiable.[6]

2.0 Lagrange Multiplier Method (LMM)

In mathematical optimization, the method of **Lagrange Multipliers** provides a strategy for finding the maximum/minimum of a function subject to constraints. The Lagrange multiplier method was basically introduced to solve constrained optimization problems with equality constraints of the form (1.1a) and (1.1c) and the theorem associated with Lagrange Multiplier Method states that:

If X^* affords a local minimum to $f(X)$ subject to the constraints $h_i(X) = 0$, then there exists a unique set of multipliers λ_i, $(i = 1, 2, \ldots, m)$ such that:

$$L(X, \lambda) = f(X) + \sum_{i=1}^{m} \lambda_i h_i(X) \qquad\qquad\qquad 2.1a$$

then,

$$\nabla L(X^*, \lambda^*) = \nabla f(X^*) + \nabla\left(\sum_{i=1}^{m} \lambda_i h_i(X)\right) = 0 \qquad\qquad 2.1b$$

and

$$L''(X^*, \lambda^*) = \frac{\partial^2 L(X^*_i, \lambda^*_i)}{\partial^2 X_i} > 0 , \; i = 1, 2, \ldots \qquad\qquad 2.1c$$

where ∇ denotes the gradient of the function and L'' denotes the second derivatives of $(2.1a)$ by Hestenes, (1975). Equation (2.1b) and (2.1c) are the necessary conditions for locally constrained minima. Equation (2.1b) and the feasibility condition (2.1b) constitute the Kuhn-Tucker necessary conditions for optimality. It is assumed that $f(X)$ and $h_i(X)$ are twice differentiable and that the gradients $\nabla h_i(X)$ are not zero at X^*. The problem can now be stated in terms of the equivalent classical Lagrangian as:

$$Minimize\; L(X, \lambda) \qquad\qquad\qquad 2.2a$$

$$Subject\; to: \; h_i(X) = 0 \; (i = 1, 2, \ldots, m < n) \qquad\qquad 2.2b$$

Assuming the existence of the saddle points of the Lagrangian (1.3), the following condition exists:

$$L(X^*, \lambda) \leq L(X^*, \lambda^*) \leq L\left(X, \lambda^*\right) \qquad\qquad 2.3$$

The optimal pair (X^*, λ^*) can be obtained by first minimizing $L(X, \lambda)$ with respect to X, then maximizing $L(X^k, \lambda)$ with respect to λ by updating $\lambda_i^{k+1} = \lambda_i^k + c[h_i(X^k)]$, where c is a scalar parameter (step size), k is the iteration number and X^k is the local minimum of $L(X^k, \lambda^k)$. The procedure is repeated until convergence is attained. Serious disadvantages are encountered in this method. First, the problem (2.3) must have a locally convex structure for the dual problem to be well defined. Luenberger, (1973). Second, a large number of iterations are usually required to minimize (2.1a), because of this, it found application in a limited class of problems where minimization of the Lagrangian (2.1a) can be efficiently carried out due to special structure, as shown by Luenberger (1973), or where the design problem exhibits a unique form, as shown by Schmit and Fleury, (1979).

3.0   PENALTY FUNCTION

Penalty Function Methods have been used extensively since the mid-1940, Pierre and Lowe, (1975), considered Penalty Function Method to be efficient for inequality constrained problems such as equation (1.1a) with respect to (1.1b). Considering (1.1a) and (1.1b), the general Exterior Penalty Function for this class of problem is defined as:

$$L(X, c) = f(X) + c \sum_{i=1}^{m} \emptyset_i(t) \qquad\qquad\qquad 3.1$$

where $\emptyset(t)$ is some scalar of the Penalty Function of the constraints and c is the penalty parameter. Now, the most common Penalty Function Method is the quadratic type where $\emptyset_i(t)$ in (3.1) is defined as: $\emptyset(t) = \frac{t^2}{2}$. However, it may be desirable at times to use other Penalty Function Method. The Quadratic Penalty Function of (1.1a) with respect to (1.1b) is given as:

$$L(X, c) = f(X) + \frac{c}{2}\sum_{i=1}^{m} p_i^2(X) \text{, where } p_i(X) = \begin{cases} g_i(X), & if \ g_i(X) \geq 0 \\ 0, & otherwise \end{cases} \qquad 3.2$$

(3.1) and (3.2) are now an unconstrained minimization. We need to note that as c in (3.1) and (3.2) gets larger, the function value changes more rapidly and the optimum becomes more difficult to find regardless of the minimization techniques. This causes the numerical ill-conditioning inherent with Penalty Methods. Interior Penalty Function Method has the advantage of approaching the optimum from the feasible region thus, yielding a feasible solution. However, the penalty function is discontinuous at the constraint boundaries. We discovered that both Exterior and Interior Penalty Function exhibit the same problem of ill-conditioning and slow convergence, the exact solution is not possible but the solution achieved is feasible.

4.0   Conjugate Gradient Method (CGM)

The development of the Conjugate Gradient Method (CGM) algorithm for solving algebraic equations can be traced to **Hestenes and Stiefel,** (1952), which was successfully applied to nonlinear equations with results reported by **Fletcher and Reeves** in 1964. The CGM algorithm for iteratively locating the minimum x^* of $f(x)$ in $\mathcal{H}$ is described as follows:

Step 1: Guess the first element $x_0 \in \mathcal{H}$ and compute the remaining members of the sequence with the aid of the formulae in the steps 2 through 6.

Step 2: Compute the descent direction $p_0 = -g_0$ and Set $x_{i+1} = x_i + \alpha_i p_i$; where $\alpha_i = \frac{\langle g_i, g_i \rangle_{\mathcal{H}}}{\langle p_i, Ap_i \rangle_{\mathcal{H}}}$

Step 3: Compute $g_{i+1} = g_i + \alpha_i Ap_i$, and Set $p_{i+1} = -g_{i+1} + \beta_i p_i$; $\beta_i = \frac{\langle g_{i+1}, g_{i+1} \rangle_{\mathcal{H}}}{\langle g_i, g_i \rangle_{\mathcal{H}}}$

Step 4: If $g_i = 0$ for some i, then, terminate the sequence; else set $i = i + 1$ and go to step 2.

In the iterative steps 2 through 6 above, p_i denotes the descent direction at ith step of the algorithm, α_i, is the step length of the descent sequence $\{x_i\}$ and g_i denotes the gradient of f at x_i. Steps 2, 3 and 5 of the algorithm reveal the crucial role of the linear operator A in determining the step length of the descent sequence and also in generating a conjugate direction of search. Generally, for optimization problems, A is readily determined and such enjoys the beauty of the CGM as a computational scheme since the CGM exhibits quadratic convergence and requires only a little computation per iteration.

Since so many researchers have worked on CGM, for the effort expended by these researchers in constructing the control operator and even the method in question (CGM) not to be limited to solving this class of problems alone, the desire to embed Lagrange multiplier (LM) and Penalty Function (PF) in Conjugate Gradient Method (CGM) for solving Engineering Constrained typed Problems was borne out and the resulting algorithm is as follows:

5.0   Lagrange Multiplier and Penalty Function Embedded in Conjugate Gradient Method (LPCGM)

The Lagrange multiplier can be perceived to be a combined primal-dual and Penalty Function. Though they are theoretically similar but their behavior is quite different. It has been shown that the original equality constrained problem (1.1a) with (1.1c) is equivalent to the classical Lagrangian (1.3). Since (1.3) is still an equality constrained problem, it can be solved by the usual Exterior Penalty Function method. The Quadratic Penalty Function is used so that first derivatives are continuous. Substituting (1.3) into (3.2) we have:

$$L(\boldsymbol{X}, \boldsymbol{\lambda}, \boldsymbol{c}) = L(\boldsymbol{X}, \boldsymbol{\lambda}) + \frac{c}{2}\sum_{i=1}^{m} p_i{}^2(\boldsymbol{X}) = f(\boldsymbol{X}) + \sum_{i=1}^{m} \lambda_i h_i(\boldsymbol{X}) + \frac{c}{2}\sum_{i=1}^{m} p_i{}^2(\boldsymbol{X}) \qquad 5.1$$

where $p_i(\boldsymbol{X}) = h_i(\boldsymbol{X})$, Equation (5.1) is referred to as Augmented Lagrange Function for the equality constrained problem. Now, we want to extend this discussion to include inequality constraints. Considering (1.1a) with respect to (1.1b), introducing slack variables, $z_i{}^2$, which is for i^{th} constraints. The problem is now an equality constrained problem and we have the Augmented Lagrange Function as:

$$L(\boldsymbol{X}, \boldsymbol{\lambda}, \boldsymbol{c}, \boldsymbol{z}) = f(\boldsymbol{X}) + \sum_{i=1}^{m} \lambda_i(g_i(\boldsymbol{X}) + z_i{}^2) + \frac{c}{2}\sum_{i=1}^{n}(g_i(\boldsymbol{X}) + z_i{}^2)^2 \qquad 5.2$$

If the number of constraints, n, in (5.2) is much greater than the number of design variables as is often the case in engineering design problems, the unconstrained minimization problem is sizable. The scope of the problem can, however, be reduced by eliminating the slack variables, $z_i{}^2$, by first minimizing (5.2) with respect to $\boldsymbol{z}$. For a local minimum to exist, the stationary conditions:

$$\frac{\partial L}{\partial z_i} = 0 \; (i = 1, 2, \dots, n) \qquad 5.3$$

must hold. Differentiating (5.2) and from (5.3),we have:

$$[2z_i(\lambda_i + c(g_i(X) + z_i{}^2))] = 0 \qquad 5.4$$

The solution to (5.4) is:

$$z_i{}^2 = -\frac{\lambda_i}{c} - g_i(X) \qquad 5.5$$

Since $z_i{}^2 < 0$ is meaningless, the solution becomes:

$$z_i{}^2 = \max(0, -g_i(X) - \frac{\lambda_i}{c}) \qquad 5.6$$

(5.6) shows that z_i is no longer an independent variable. From this (5.6), it is observed that if $g_i(X)$ is a critical constraint, $z_i = 0$ and if otherwise, $z_i > 0$. Therefore :

$$g_i(X) + z_i{}^2 = \max(g_i(X), \; -\frac{\lambda_i}{c}) \qquad 5.7$$

with the slack variables eliminated, the augmented Lagrangian becomes:

$$L(\boldsymbol{X}, \boldsymbol{\lambda}, \boldsymbol{c}) = f(\boldsymbol{X}) + \sum_{i=1}^{m}\left(\lambda_i p_i + \frac{c}{2}q_i{}^2(\boldsymbol{X})\right) \quad \text{where} \quad q_i = \max(g_i(X), \ -\frac{\lambda_i}{c}) \qquad\qquad 5.8$$

Equation (5.8) is referred to as Rockafellar's augmented Lagrange Function. It must be noted that since we have succeeded in converting inequality constrained problem to an equivalent equality constrained problem, it invariably mean that the convergence properties are identical.

At this junction, we now apply one of the methods used for solving unconstrained optimization problem which is Conjugate Gradient Method with some modification to suit a constrained problem (both equality and inequality) and this resulted to the following steps:

6.0   Lagrange Multiplier and Penalty Function Embedded in Conjugate Gradient Method (LPCGM) Algorithm

Using this proposed method, some steps are involve which are very important after our investigation; we now draw out the following steps which serves as guild to solving some constrained optimization problems. The steps are as follows:

Step 1: Choose an Lagrange Multiplier $\lambda > 0$, Penalty parameter $c > 0$ and guess the initial elements X_0.

Step 2: Formulate the unconstrained minimization problem:

$$Min\ L(X, \lambda, c) = f(\boldsymbol{X}) + \sum_{i=1}^{m}\left(\lambda_i q_i + \frac{c}{2}q_i{}^2(\boldsymbol{X})\right) + \sum_{j=1}^{m+n}\left(\lambda_j h_j(\boldsymbol{X}) + \frac{c}{2}h_j{}^2(\boldsymbol{X})\right) \quad \text{where}\ q_i = $$
$$\max(g_i(X), \ -\frac{\lambda_i}{c})$$

Step 3: Compute the initial gradient, g_0, as well as the initial descent direction, $q_0 = -g_0$

Step 4: Compute the Hessian Matrix, H, in step 2 and Set $x_{i+1} = x_i + \alpha_i q_i$, where $\alpha_i = \dfrac{g^T{}_i g_i}{q^T{}_i H q_i}$, $i = 1, 2, \ldots, n$

Step 5: Update the gradient and descent direction using $g_{i+1} = g_i + \alpha_i H q_i$ and $q_{i+1} = -g_i + \beta_i q_i$ respectively, *here* $\beta_i = \dfrac{g^T{}_{i+1} g_{i+1}}{g^T{}_i g_i}$, $i = 1, 2, \ldots, n$, if $g_i = 0$ stop, else, set $i = i + 1$ and return to step 4

7.0   EXPERIMENTING LPCGM ALGORITHM

Considering (1.1) , there exists a Lagrange Multiplier λ and Penalty parameter p which are used to convert (1.1) to give a Lagrangian function such as:

$$L\big(X, \ \lambda\big) = f(X) + \ \sum_{i=1}^{n}\lambda_i h_i(X) + \sum_{i=1}^{n}\frac{c}{2}q_i{}^2(X) \qquad\qquad 7.1$$

Let the initial guess be:

$$x_0 = \begin{pmatrix} x_{1(0)} \\ x_{2(0)} \\ . \\ . \\ . \\ x_{n(0)} \end{pmatrix} \qquad \lambda = \begin{pmatrix} \lambda_{1(0)} \\ \lambda_{2(0)} \\ . \\ . \\ . \\ \lambda_{n(0)} \end{pmatrix} \qquad C = \begin{pmatrix} C_{1(0)} \\ C_{2(0)} \\ . \\ . \\ . \\ C_{n(0)} \end{pmatrix} \qquad 7.2$$

Putting (7.2) in (7.1) and (5.6) respectively gives the initial functions values i.e. $f(X_0)$ and $L(X_0, \lambda, c)$.

Computing the gradient of (7.1) with respect to $(x_1, x_2, \ldots, x_n)^T$ and putting (7.2) gives us the initial gradient and the descent direction as:

$$g_0 = \begin{pmatrix} \frac{\partial}{\partial x_1}L(x_0,\lambda,c) \\ \frac{\partial}{\partial x_2}L(x_0,\lambda,c) \\ . \\ . \\ . \\ \frac{\partial}{\partial x_n}L(x_0,\lambda,c) \end{pmatrix} \qquad q_0 = -g_0 = \begin{pmatrix} -\frac{\partial}{\partial x_1}L(x_0,\lambda,c) \\ -\frac{\partial}{\partial x_2}L(x_0,\lambda,c) \\ . \\ . \\ . \\ -\frac{\partial}{\partial x_n}L(x_0,\lambda,c) \end{pmatrix} \qquad 7.3$$

the Hessian Matrix gives:

$$H = \begin{pmatrix} \frac{\partial^2 L(x_0,\lambda,c)}{\partial x^2_1} & \frac{\partial^2 L(x_0,\lambda,c)}{\partial x_{12}} & \cdots & \frac{\partial^2 L(x_0,\lambda,c)}{\partial x_{1n}} \\ \frac{\partial^2 L(x_0,\lambda,c)}{\partial x_{21}} & \frac{\partial^2 L(x_0,\lambda,c)}{\partial x^2_2} & \cdots & \frac{\partial^2 L(x_0,\lambda,c)}{\partial x_{2n}} \\ . & . & & . \\ . & . & & . \\ . & . & & . \\ \frac{\partial^2 L(x_0,\lambda,c)}{\partial x_{m1}} & \frac{\partial^2 L(x_0,\lambda,c)}{\partial x_{m2}} & \cdots & \frac{\partial^2 L(x_0,\lambda,c)}{\partial x_{mn}} \end{pmatrix} \qquad 7.4$$

On transposing (7.3) respectively and multiplying them gives us a scalar, k .i.e. $k = g_0^T g_0$

$$k = \left(\left(\frac{\partial}{\partial x_1}L\left(x_0,\lambda,c\right) \right)^2 + \left(\frac{\partial}{\partial x_2}L\left(x_0,\lambda,c\right) \right)^2 + \ldots + \left(\frac{\partial}{\partial x_n}L\left(x_0,\lambda,c\right) \right)^2 \right) \qquad 7.5$$

Similarly, a scalar, z .i.e. $z = q_0^T H q_0$, gives:

$$z = \begin{pmatrix} -\frac{\partial}{\partial x_1}L(x_0,\lambda,c)\left(\frac{\partial^2 L(x_0,\lambda,c)}{\partial x^2_1}\left(-\frac{\partial}{\partial x_1}L(x_0,\lambda,c)\right) + \frac{\partial^2 L(x_0,\lambda,c)}{\partial x_{12}}\left(-\frac{\partial}{\partial x_2}L(x_0,\lambda,c)\right) + \ldots + \frac{\partial^2 L(x_0,\lambda,c)}{\partial x_{1n}}\left(-\frac{\partial}{\partial x_n}L(x_0,\lambda,c)\right) \right) \\ -\frac{\partial}{\partial x_2}L(x_0,\lambda,c)\left(\frac{\partial^2 L(x_0,\lambda,c)}{\partial x_{21}}\left(-\frac{\partial}{\partial x_1}L(x_0,\lambda,c)\right) + \frac{\partial^2 L(x_0,\lambda,c)}{\partial x^2_2}\left(-\frac{\partial}{\partial x_2}LL(x_0,\lambda,c)\right) + \ldots + \frac{\partial^2 L(x_0,\lambda,c)}{\partial x_{2n}}\left(-\frac{\partial}{\partial x_n}L(x_0,\lambda,c)\right) \right) \\ . \\ . \\ . \\ -\frac{\partial}{\partial x_n}L(x_0,\lambda,c)\left(\frac{\partial^2 L(x_0,\lambda,c)}{\partial x_{m1}}\left(-\frac{\partial}{\partial x_1}L(x_0,\lambda,c)\right) + \frac{\partial^2 L(x_0,\lambda,c)}{\partial x_{m2}}\left(-\frac{\partial}{\partial x_2}L(x_0,\lambda,c)\right) + \ldots + \frac{\partial^2 L(x_0,\lambda,c)}{\partial x_{mn}}\left(-\frac{\partial}{\partial x_n}L(x_0,\lambda,c)\right) \right) \end{pmatrix} \quad 7.6$$

to get the initial step length, we use $\alpha_0 = \dfrac{g^T_0 g_0}{q^T_0 H q_0}$ which can simply be gotten from (7.5) and (7.6) respectively. Now set $x_{i+1} = x_i + \alpha_i q_i,\ i = 0,\ 1,\ 2,\ \dots,\ n$.

8.0 Data Analysis

With the developed algorithm for Lagrange Multiplier and Penalty Function embedded in Conjugate Gradient Methods (LPCGM), we now apply the method to an engineering constrained optimization problem which is a quadratic function. This function is subject to linear, nonlinear and inequality constraints. The table of result for this problem is as follows:

Problem 1

$Min\ f = (x_1 - x_2)^2 + (x_2 + x_3 - 2)^2 + (x_4 - 1)^2 + (x_5 - 1)^2$

$Subject\ to$: $x_1 + 3x_2 \leq 0$

$x_2 - x_4 - 2x_5 = 0$

$x_2 - x_5 \leq 0$

9.0   Table 1: Table of Result for problem 1

It |	X(1)	X(2)	X(3)	X(4)	X(5)	FV	Alfa	G*GT	Beta
0 |	2	2	2	2	2	70	0	0	0
1 |	1.785716078596	0.92858033	2.05357098	1.75893057	2.53570983	12.4379783	0.13392746e-1	0	
2 |	0.21699105	-0.46953752	4.20298643	0.2823569	-0.72421736	-8.42598613	0.51860834	80.4613535	0.9360325e-2
3 |	-0.3647372	-1.19577461	4.99007296	-0.24771488	-1.54482321	-2.83819616	0.10832661e-1	1248.13076	15.512177
4 |	-0.541750691	-1.39354356	5.32378142	-0.36434898	-1.5671256	1.73663368	0.19691487e-1	144.268189	0.1155874
5 |	-1.43238023	-1.69691014	7.68095155	-0.73402633	-1.38843562	4.66611907	0.10509827	115.292829	0.79915628

Table 1, shows the numerical solution of problem 1. Using LPCGM, The problem converged at the 5th iteration with: Calculated value = 4.166611, Analytical solution = 4.0930. The calculated value compares favourably with the analytical solution. This shows that the scheme developed in this paper is quite effective.

10.0 CONCLUSION

Computationally, the resulting scheme of the embedding Lagrange Multiplier and Penalty Function in Conjugate Gradient Methods was tested on two constrained optimization problems. The good side of the scheme is that it is not only effective; it converges much faster than the function space method and the multiplier method. Convergence is at the 5th and 4th iterations respectively. The results obtained for the tested problems are very close to the analytical solutions.

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CHILD POVERTY AS SOCIAL CONFLICT: HOW EMPHASIS ON MIDDLE-CLASS CULTURE IN TEACHER EDUCATION DISADVANTAGES STUDENTS IN POVERTY

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Introduction

In 1989 a resolution to eliminate child poverty in Canada by the year 2000 passed with unanimous support from all parties in the House of Commons (Ismael 1). Since then child poverty in Canada has gotten worse not better. The child poverty rate in Canada has increased from 15.8% to 19% in 2013 (Campaign2000 3). That is about 1,334,930 children in Canada who live in poverty (3). For these children, poverty has serious impacts on their development including lack of access to basic nutrition, safe neighbourhoods, adequate housing, products or services that promote physical, social, intellectual and emotional development, and poorer overall health (Albanese 30-42). For many, it is surprising that child poverty is such a widespread and persistent problem in Canada. Shereen Ismael traces Canada's loss of its social welfare state of the mid-twentieth century back to the very 1989 declaration to eliminate child poverty. By transferring responsibility for social policy from federal to provincial government and then limiting that responsibility to the 'deserving poor' (children and the disabled), the state passed responsibility from itself to civil society which has resulted in the normalization of child poverty (Ismael 86-88).

Without government responsibility and accountability, how Canadians view poverty becomes especially important as the way we recognize and define poverty influences our social action (or inaction) (Redden 821). Canadian mainstream news stories on poverty focus mainly on government action (or plans for action) and in these stories "[t]he emphasis on cost provides an immediate indication that the government is doing something" and neglects addressing "when governments step away from proposals, or say they are unaffordable" (828). News media imagery of the poor as an 'underclass' "in relation to crime, addiction, laziness, or descriptions of where the poor live as undesirable or unsafe" further augments the idea that individuals are to blame for their own poverty (831). After 27 years of government failure to take action, the general belief that those in poverty are lazier or more inept than other Canadians, and the effects of poverty on those living in it, poverty can then be seen as a protracted social conflict (PSC). Canadians living in poverty meet the conditions of PSCs in that they have a communal/group identity (Ramsbotham 100) as far as class consciousness, they experience a deprivation of non-negotiable human needs as a group (101), the state plays a key government role in satisfying or frustrating their individual or group needs (101), and international linkages, such as the effect of the world market on a national economy, impacts this group disproportionately (103, Albanese 59). A top-down approach to conflict resolution from leadership to the people (Gawerc 443) has failed to materialize. Bottom-up approaches from the people through to the leadership (443) are also not a viable solution to child poverty as children don't yet have the means to advocate for themselves, their parents lack agency and clout, and other Canadians often experience poverty through the media and as such don't make it a priority to address. Thus a "track two" approach where scholars, opinion leaders, and concerned others work together to clarify long-standing the situation, humanize "the other," and explore possibilities for resolution (444), is the most fitting approach.

Schools can play a role in children's development and life trajectories but this is particularly challenging when schools themselves have become systems focused on producing economically productive citizens (Cardinal 25). In fact, in Ontario families that earn $30,000 or less per year children score 20-30% lower on Grade 3 EQAO standardized tests in math and literacy compared to kids in families with incomes of more than $100,000 a year (TVO). This gap increases in Grade 6 and by high school, 50% of students who drop out are from families who earn less than $30,000 a year (TVO). The

pivotal role then falls not on schooling as a system, but on individual teachers who "face the challenge of teaching not only students with a variety of cognitive abilities and students from diverse cultures but also impoverished children and disengaged families" (Cardinal 25). Thus I am researching child poverty in Canada (Ontario) to find out what are effective critical pedagogy approaches that encourage junior and intermediate teachers to recognize curriculum, teaching and personal practices that overlook the lived realities of their students and thereby add to societal class conflict, and what are pedagogical best practices to develop student agency in changing their life trajectories? I will do this in order to encourage a culture that supports youth below the poverty level to envision and create a future for themselves outside of the cycle of poverty.

Theoretical Approach and Methodology

In viewing child poverty as a protracted social conflict which requires an educational intervention, I will use an analytical framework that includes elements of two different theories. First, Pierre Bourdieu's and Jean Claude Passeron's *Reproduction in Education, Society and Culture* will be useful in locating and articulating power asymmetries embedded in school cultures. Next, Michel Foucault's disciplinary theory of culture views culture as systems of surveillance, "disciplining the body and formulating the subjectivities of students" (Cho 61). Foucault's theory provides the opportunity to identify hierarchical forms of knowledge-production and how they come to shape and encompass beliefs. Further, I will take Seewha Cho's approach to critical pedagogy where the traditional goal of critical pedagogy – fixing/improving the system and teaching those who have power to share – is insufficient when the oppressive system remains, and thus the goal is to dismantle systems of oppression (Cho 157).

My methodology in exploring pedagogical practices with respect to students in poverty will consist of analyzing the frameworks and teaching practices being taught to future teachers in the University of Ottawa's (uOttawa) Bachelor of Education (B.Ed) program. I will be looking specifically at learning in the intermediate/senior division which covers teaching of students from Grades 7 to 12, and explore core courses that speak to teaching practices and student realities. My analysis of B.Ed curriculums will inform my understanding of how the teaching paradigms taught to B.Ed students influence teaching practices and can affect students in poverty.

Results

Teaching Practices and Poverty

My analysis of UOttawa's B.Ed course literature found that the majority of the material that addressed poverty directly was segregated from the mainstream, dominant or "universal" teaching practices. The material that addressed poverty also often conflicted with or outright contradicted the teaching practices taught to B.Ed students. Within the course readings is a Ministry of Education document which describes their basic teaching model under the title *Planning for Inclusion*. The first of the two steps in *Planning for Inclusion* is *Universal Design for Learning* (UDL) which is defined as "an orientation intended to shape teaching in order to provide all students with access to the curriculum" (Education for All 10). This document presents this orientation as a positive teaching format for all that gives entry and equalizes. When Bourdieu and Passeron wrote about pedagogy as a "'culture for the masses' programme of 'liberating' the dominated classes by giving them [the dominating class] the means of appropriating legitimate culture" it is as if they are speaking directly about UDL (24). UOttawa's intermediate B.Ed course readings recognize that education tends to have a moulding function that "favours the dominant culture and values, which results in the reproduction of asymmetrical relations in wider society" (Pearson 69). The same text tells us who is doing the imposing on whom through UDL, "most Canadian teachers are middle class, White, and monolingual, and they are teaching a student population that is increasingly diverse in race, language, culture, ethnicity, ability, and social class" (84). It also provides examples of how policies become realities that are unequal, such as the Ministry of Education's Safe Schools Act which has "had a disproportionately negative impact on visible minority (especially Black) students, those with disabilities, and students from low income backgrounds" (Pearson

88). If we consider *Universal Design in Learning* as a technique to order groups (Foucault 207), we'd find that UDL first obtains power by suggesting that it's possible to have a universal "norm" that benefits all, when it actually establishes legitimacy and gives power to the dominant group in society. It does this economically: by claiming that UDL is "universal" the Ministry of Education spares themselves the expense of having to provide multiple teaching strategies or even multiple schooling systems. It also works politically; by labeling UDL under *Planning for Inclusion* and speaking to the diversity of learners UDL can apply to, the Ministry of Education rewrites the power distribution of UDL, presenting it as something that is equalizing rather than hierarchical. UDL also spreads the reach of its power through the perception that it is inclusive; by framing the idea that one way (the way of the dominant group) is good for everyone, UDL convinces even those it disadvantages of its benefit and enlists their support in ensuring its ongoing success. And last, UDL ensures the students educated within UDL are immersed in the manners, customs, ideas, culture and superiority of the dominant group, with each successive group educated this way increasing the power of the dominant group. B.Ed students are taught that a "classroom based in UDL is specifically planned and developed to meet the special needs of a variety of students, including students who are disabled and those who come from a non-dominant culture. It is flexible, supportive, and adjustable, and increases full access to the curriculum for all students" (Education for All 10). In other words, future teachers are taught that this teaching practice accommodates and gives concessions, without recognizing that the need for those accommodations comes from constructs of a superior, better, or normative way of being.

The second step in *Planning for* Inclusion, *Differentiated Instruction* (DI), is based on the idea that individualized teaching practices benefit students. DI acknowledges the diversity among Ontario students and asks teachers to "adapt pedagogical interventions to the needs of the student, acknowledging that each student differs in interests, learning profile, and level of functioning. Differentiated learning may facilitate high levels of both student engagement and curricular achievement" (Education for All 14). This sounds like a very student-oriented teaching philosophy, except for the fact that differentiation is limited to how things are taught: "Curriculum tells teachers what to teach, while differentiated learning tells teachers how to teach it to a range of learners by employing a variety of teaching approaches" (14). Instead of accommodating the knowledge, experiences and issues important to the student, the accommodations made through *Differentiated Instruction* work to ensure that the curriculum, and the legitimization of the dominant group and culture within it, is absorbed by all. Further it's suggested that "[t]eachers can help accelerate students' cognitive development (Vienneau 2005) by supporting children in resolving problems, by questioning their conceptions, and by asking them to justify their positions" (Education for All 14). This assumes that the roadblock to student cognitive development is necessarily the student's conceptions of the world, and that helping the student leave what they know for what they are being taught is the solution. What the student has learned about the world from their lives and social contexts are challenged as conceptions or beliefs, while what is being taught in curriculum is presented as uncontested knowledge or in another word, as truth. This pedagogical practice would fall under what Bourdieu and Passeron describe as methods "to inculcate the fait accompli of the legitimacy of the dominant culture … by making those it relegates to second-order teaching recognize the inferiority of this teaching and its audience" (41). Thus, *Universal Design for Learning* first Others students by suggesting an arbitrary norm and then recognizes that some students don't fit and therefore need to be accommodated. *Differentiated Instruction* recognizes that conflicts between student individuality and generalized standards/"universal" norms slow down the acquisition of knowledge, but differentiates only so far as to help students absorb and accept the knowledge being presented.

A further method proposed to create equity and inclusion that is given significant space in the course teachings is a process called Checking for Bias in Materials (CBM) (Pearson 281). The section on CBM recommends inclusive pedagogy where "teachers must identify how they plan to engage students in ways that enable them to question the knowledge that is being taught" (281-282). My initial research showed that Canadians have a tendency to individualize poverty rather than consider the systemic

reasons. Unless teachers are trained to seek out their own biases with respect to poverty, it can also be argued that teacher self-inquiry searching for bias will fall short, because the bias they seek exists inherently within the structure they are taught to think in. For that matter, if teachers lack the ability to see the structural hierarchy engrained in their own teacher training and education, how can they be expected to teach their students to seek out and rewrite dominant narratives for self-empowering ones? For example, in teaching the application of CBM, the text says that "in cases where there are First Nations children in the class, teachers must ensure that instructional aids have some relevance to the culture of Canada's First Nations peoples" (Pearson 281). I'll start with the obvious: that First Nation's history and culture is not already included in every classroom's teaching practice and instructional aids is itself a part of the ongoing erasure of Aboriginal People to the advantage of the dominant group. Further, suggesting that it needs to be included *where there are First Nations children in the class,* shows a commitment to demonstrating inclusion and equity, rather than creating it in classrooms and society. Rather than teaching students to explore their interrelationships with First Nations and questioning Canadians to explore the origins of our opportunities for prosperity, CBM in the given example works to "introduce, between the different elements at the same level, as solid separations as possible" (Foucault 209). A second problematic example of CBM is cross-cultural teaching. The Pearson text states, "[a]rguably, it may not be possible to include resources that are representative of every student in the class… A useful strategy for including materials that are culturally relevant is to select resources that cut across cultures" (Pearson 281). From the perspective of the dominant group who consider themselves graciously accommodating those outside the norm, teaching acceptance of a generic Other is kindness enough. Yet for individual Othered students, who can perceive that this token representation is supposed to represent them but knows that it does not, it can create a conflicting sense of identity, resentment or self-rejection. The combination of *Universal Design for Learning*, *Differentiated Instruction*, and *Checking for Bias in Materials* seems great to those in the dominant group because it is an example of their graciousness in accommodating those who are different. For those students, such as those living in poverty, who are deemed outside the norm, excluded and Othered through symbolic relations of power and skewed pedagogical practices, and then made dependent on the graciousness of the dominant group due to this Othering, these teaching practices come across as slightly less great.

Poverty in Course Readings

Very little of my analysis so far has been directly about poverty. This is because very little of the discussion on teaching practices within the course readings spoke directly to teaching students in poverty or to teach students about poverty. While the Ministry of Education includes socio-economic status in its definition of diversity (Realising the Promise of Diversity 4), it's various sections about diversity such as "Sample Questions for Analyzing Texts for Bias and Stereotypes" (Pearson 81), "The Need for Action" (Realising the Promise of Diversity 7), "The Changing Face of Ontario" (8), and "Combatting Prejudice and Discrimination" (Pearson 295-302) all focus on examples to do with racial prejudice, homophobia, religious intolerance and gender-based violence, Aboriginal Peoples, family dynamics, newcomers, and other visible minorities. There are two places where poverty is addressed directly in the course readings. The first is the Elementary Teachers Federation of Ontario's (ETFO) guide, *Poverty and Learning.* It acknowledges poverty on many levels including its prevalence (11) the external supports students may have (13), ideas to improve at the school level (9, 14), Aboriginal students (17-20), the use of art to enrich education (36-41, 42-44), and the need for government action (20-22). It also looks at poverty in city schools (23-25), including the story of children in an inner city school (26-29). This however, is told from the perspective of what the school provides for the children, not the narrative/experience of the child. As far as teaching practices and poverty the guide provides two examples. The first is the narrative of Ainsworth Morgan, a teacher who grew up in poverty himself. This is the only example of agency for those in poverty in all the readings analysed where someone from within poverty is a subject and a Subject who is capable of creating/authoring his own future (Spivak 66-70). Morgan suggests that sometimes the most effective teaching moments happen outside of teaching time and that change can require large amounts of a teacher's personal time. He states that this style of outreach is "crucial for

children from marginalized families and, I would argue that it is necessary for effective teaching and learning to occur" (ETFO 32). The second place where poverty is directly addressed within the ETFO guide is an article called *Bridging the Gap* which discusses the efforts of middle class teachers to help their students in need. It discusses how one school used funds from ETFO to enrich student learning through field trips to see a symphony orchestra, buy recorders for Grade 5 students, and student-designed t-shirts for their recorder performance (46). The other place where readings address teaching practices with respect to poverty is within the course readings for PED 3102 – *Schooling and Society*. Cumulatively, the readings in PED 3102 provide critiques of dominant cultures, the need to dismantle systems of power, and descriptions of various projects and strategies that try to do this. Overall the readings discuss the alienation those in poverty face (Ibrahim 82-85), recognition that the poor are rarely the subjects of a fairytales and often portrayed negatively (111), and alternative teaching methods that take the risk of engaging students with learning from where they are, such as Hip Hop (127). However, as with Ministry documents in the readings, when it comes to diversity issues; poverty falls short compared to other minority issues. Thus poverty is somewhat addressed in the B.Ed course readings analysed, however it is segregated from mainstream teaching practices and opportunities to teach students in poverty a sense of agency is largely missing. The placement of information plays a role in how it is classified, understood and absorbed. Bourdieu and Passeron discuss how "[t]he teaching tolls which the education system [sic] makes available to its agents (manuals, commentaries, abstracts, teacher's texts, syllabuses, set books, teaching instructions, etc.) must be seen not simply as aids to inculcation but also as instruments of control tending to safeguard the orthodoxy … against individual heresies." (58). *Individual heresies* are exactly the right term for the sidelined readings on poverty in the ETFO guide and PED 3102. The Ministry of Education documents and course textbooks constitute the main body of information on how teachers shape their practice while what information on poverty is available is sidelined amongst other issues from various minority perspectives to keep in mind.

Discussion

Reading about teaching practices in UOttawa's B.Ed course literature through the lens of "universal" norms and hierarchical groupings shows how exclusionary it can be to those in poverty. However, for those who don't take a critical approach to the course readings, it may be difficult to see the power asymmetry created by dominant teaching practices. Further, it would be understandable for B.Ed students, particularly ones from "normative" backgrounds or who grew up the dominant culture to feel frustrated at having an entire course designated to minority voices when the basis of their teaching practice has already "planned for inclusion," "differentiated" their instruction strategies, checked for biases (except for structural ones), and modified and accommodated at what seems like every turn. So while marginalized readings may include ones such as the suggestion that teachers take the risk of incorporating Hip Hop into their teaching even if it's something they know nothing about to meet their student's reality, real world actions sometimes look like the middle class teachers in the ETFO, *Poverty and Learning* guide who took underprivileged children to a symphony orchestra in order to give them an alternate world they should move towards. A symphony orchestra, by nature of its costs, the halls it is performed in, the conventional dress codes involved symbolically represent higher social classes. Thus the rare sidelined alternative teaching practice provided for helping students in poverty are not a widely implementable as a strategy for helping students find solutions out of poverty when middle class teachers – even ones who are looking to bridge gaps – have themselves been raised as students in this hierarchical system of reproduction. The silent culture of the norm centered within teacher thought processes guide their solutions take the form of helping students in poverty by exposing them to the benefits of middle and higher social classes, rather than reorganizing school and classroom culture to include the realities and experiences of the students. For poverty education to be a viable solution, teachers have to be explicitly taught how to recognize, dismantle and rewrite pedagogies into ones that benefit their students. Similarly the suggestion of Ainsworth Morgan that teachers put in extra work, particularly outside of teaching hours, is unrealistic in its application. While I admire his personal commitment to his students, teaching strategies to break the cycle of poverty cannot be dependent on voluntary extra work from

teachers. For a large scale change to occur, the solution needs to engage strategies that assume teacher commitment and avoid teacher burnout. The ETFO guide provided the largest consolidated information on poverty but its solution depended mostly on trying to enlist teachers in extra work with unpaid hours and seeking funding and resources. These are conditional and dependent strategies and therefore unreliable. It is necessary to adapt to truly inclusive pedagogies and practices so that teaching practices themselves don't first exclude students in poverty and exacerbate the cycle and then ask teachers to remedy the problem with voluntary work.

Yet teachers cannot teach their students how to identify and articulate cultural domination in school and society, if they are incapable of doing it in their own education. The topic of what can be done to make teacher education a self-critical process is one for another study, however, the results of my analysis suggest a few directions that may be fruitful in exploring. First, considering the tendency for reproduction within education, if Faculties of Education and Education professors truly believe in student-driven learning, they need to model it. Understandably each scholar or researcher has the tendency to teach what they know and has the desire to focus their own learning on what they are passionate about. However in order to serve the diversity of learning needs and objectives that arise through true student-driven learning of B.Ed students, the use of regular communal praxis meetings can help Faculties of Education engage in the kind of critical awareness (Freire 69) which allows educators to see what their students need to learn and to rely on each other as resources to meet those needs. Only through continual analysis of the meta-effect of a program's teachings can faculties determine their systemic imprint. Second, as noted throughout my results, poverty cannot compete with the myriad issues within critical pedagogy and that a teacher must contend with in the classroom. Thus, rather than compete to pre-define the importance of issues in the classroom, a true student-based pedagogy would be comfortable with letting go of planned teaching, to explore with students what about the teaching disrupts them as it comes up. The practice of true student-led learning – sharing leadership with multiple bodies with a multitude of ideals, values, fears and ways of thinking – will necessarily result in relative classroom chaos. For educators to realize that classroom chaos does not necessarily signal the end of learning, but a resistance against planned learning, can free them to share power with students in exploring and learning with students (Buber 130). If B.Ed educators can acknowledge the management and efficiency-based pedagogy in Ministry documents and dominant texts, and shift away from efficiency and discipline in their own practice, they can exemplify for B.Ed students how an educator can cultivate learning results from within the chaos of a multitude of ideals, backgrounds, experiences and learning needs of their students. And finally, B.Ed programs can help future teachers give their students space to articulate their struggles by allowing B.Ed students the space to explore what they are feeling about what they are learning. Through this exploration students may find their dislike or indifference towards certain readings, subjects or school learning in general has less to do with their own interests or intelligence and more to do with the contradiction the material creates between the world it presents and the world the students know. Narrative assignments are one way to encourage this exploration. Research in narrative identity literature has shown that adults who are resilient to negative life experiences engage in a) reflection on the feelings the experience brings up, how the situation came to be, and what it may lead to, and b) the articulation and commitment to a positive resolution (McAdams and McLean 234). Allowing students the space to be subjects lets them explicitly explore how they feel about what they are learning and why they feel that way. With this awareness, it becomes possible for them to be Subjects who identify power hierarchies within their learning and overcome them. To close, child poverty is a persistent problem in Canada. Schools can serve as instigators toward a solution, but only if teacher education identifies the dominant structures and hierarchical nature of education as well as models practices for future teachers that help them apply pedagogical practices that put student needs first, engage in the chaos of embracing multiple priorities and needs, and teach them that teaching needs to validate the feelings, experiences, and lived realities of their students.

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CONCEPT MAPS AS A FORM OF STUDENTS' ASSESSMENT AND INSTRUCTIONS IN MECHANICAL ENGINEERING EDUCATION

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Abstract-

Using a quasi-experimental design, we investigate whether concept maps generated by students benefit them in the learning of the topic of introduction to the internal combustion engines (IICE) in mechanical engineering education. The participants were 134 third year undergraduate students enrolled in the IICE course in the University of Mumbai. The students were assessed at different levels of Bloom's taxonomy of learning. The experimental group consisting of 64 students performed significantly better at the knowledge level and the application level compared to the of the control group consisting 70 students. Students' positive perception towards concept maps in the present study could also be a factor explaining the positive impact of concept maps on learning. It is evident that concept maps are a useful tool in assessing students' knowledge and application in the subject of IICE.

Keywords- *Concept maps, Bloom's taxonomy, introduction to the internal combustion engines (IICE)*

Introduction

Nowadays, many engineering institutes are seeking better ways to enhance the quality of instructions (Adams, R. et al., 2011). Teachers of engineering colleges have to organize their course in a way that it should be easy to understand for the students but at the same time it should illustrate complex core concepts of engineering.

In order to teach effectively, a teacher has to understand how students are learning, what are the easy concepts and what are the difficult concepts for the students to grasp. Finding the relationship between concepts is one of main feature of the instructions (Gunstone and Northfield, 1994; Bransford et al., 2000). In 1972, Novak suggested concepts maps as a technique to enable students to represent concepts and show interrelationships among concepts (Novak et al. 1990). The first objective of the present study is to learn about how students arrange the knowledge in a mechanical engineering course. The second objective is to implement concept mapping as a teaching- learning strategy to enhance the performance of the students. The last objective is to know the students perceptions about the use of this teaching- learning strategy.

An internal combustion engine is one of the major subjects of mechanical engineering curriculum. In this subject, the concepts are more abstract and difficult to understand (Porto et al., 1995). The attrition rate is very high in this subject because there are lots of concepts and students are not able to apply these concepts in higher levels of learning namely problem solving, applying the concepts, synthesis, etc.

This paper presents a case study on the use of concept mapping as a teaching- learning strategy in the classroom teaching of the topic introduction to internal combustion engines (IICE) in an undergraduate mechanical engineering course. The main goal of this approach is help students to integrate concepts in their previous knowledge, thus leading to meaningful learning. The construction of concept maps may reveal weakness and misunderstanding of the concepts.

Concept mapping

The process of learning starts with learning basic terminology and facts of the subject. After learning the basic concepts and facts, students should be able to combine them to understand the concepts. The more concepts a student's knows, it is easy for him to generalize and apply in different contexts. Classroom lecture is one source to transmit the concepts but for most of the students, it is not effective way. So a classroom lecture must be supplemented by additional techniques such as homework, textbooks and the use of visuals. A concepts map is one such pedagogical tool to help students to organize their knowledge structure (Novak, 2002, Novak and Canas, 2006). Concepts maps are a network of concepts. This network consists of nodes and links. A node represents concepts and links represent relationships among such concepts. A link is also called as preposition. A core concept is placed at the top of the map and primary and secondary concepts are placed subsequently to form a hierarchy. Examples can be given at the bottom of the map. The use of concept maps improves teaching- learning processes as empirically verified by various researchers (Novak, 1998; Heinzefry and Novak, 1990**;** Hay, Kinchin and Lygo-Baker, 2008).

Purpose of the present study

The main purpose of the study was to determine the effects of the use of student generated concept maps on students' achievements on the topic of introduction to the internal combustion engines (IICE) in an undergraduate mechanical engineering course.

Three research questions were formulated for the study. The research questions are:

1. Will the third year mechanical undergraduate students who are taught to construct concept maps have significantly higher achievements on the topic of introduction to the internal combustion engines (IICE) achievement tests than third year mechanical undergraduate students who are not taught to construct concept maps?
2. Will there be a significant correlation between students' mastery of creating concept mapping skill and their achievement in the topic of IICE?
3. Will there be any effect of the concept mapping method on students' attitudes towards the topic of IICE?

Design

To answer the research questions, the quasi experimental design of pre and posttest with a control group was used**.** Participants in this study were 134 third year undergraduate mechanical engineering students from the University of Mumbai, India. They were randomly divided into two groups. One group of 64 (n = 64, 52 boys and 12 girls, Table 1) students was randomly assigned as the experimental group; the other group of 70 (n = 70, 55 boys and 15 girls, Table 1) students was used as the control group. The experimental group was taught the topic of IICE with concept maps while learning, while the control group was taught with the traditional teaching method. The teacher and the textbooks for both groups were the same to avoid confounding effects on the experiment. Content validity of the questions was achieved by consulting with an expert teacher from the same college. No student in the class reported previous experience in the use of concept mapping.

Table 1 The distribution of participants according to gender and groups.

	Experimental group		Control group		Total
Gender	n	%	n	%	
Male	52	81.2	55	78.5	107
Female	12	18.8	15	21.5	27
Total	64	100	70	100	134

n: number of students in groups; %: percentage of students in groups.

Instruments: Achievement tests in the topic of IICE

In this study, the independent variable is using or not using concept map while learning and the dependent variable is the students' achievements in the topic of IICE. We used two objective tests to measure the achievements of the students. One of the tests measured students' pre-requisite knowledge in the topic of thermal engineering. (30 questions) The second test (post-test) measured students' achievement in the topic of IICE at the conclusion of the study. The reliability KR-20 of the pre-test was 0.71 while that of the post test of the topic of IICE was 0.79.

A satisfaction questionnaire was given to the students at the end of this study to examine the attitude of students towards concept mapping to learn the topic of IICE. The questionnaire was comprised of 10 items, and was rated on a five-point Likert scale from 'strongly disagree' to 'strongly agree'. The Cronbach Alpha coefficient of the instrument was 0.82.

Blooms' taxonomy (1969) was used to ensure that the test items in the post test were at the different cognitive levels. The test questions used in this study are at the knowledge, comprehension, application and numerical levels. In the post test, there were a total of 40 questions related to the topic of IICE.

According to Bloom's taxonomy, the distribution of the questions related to topic of IICE in the post test is as shown in Table 2

Table 2 Distributions of the questions according to Bloom's taxonomy

Level	Third year mechanical engineering students
Knowledge	10
Comprehension	10
Application	10
Numerical	10
Total questions	40

There are several ways in which a student can create concepts maps. Many softwares like Cmap, Insprion and Edraw Max are available for this purpose. The present study used a method where the students produce their own concept maps on paper and their maps are compared with the expert map created by subject teacher.

Concept map scoring rubric

The present study has used following approach for evaluating students' concept map (McClure, J.R., Sonak, B. and Suen, H.K., 1999). The scoring rubric of concept maps was explained to the students by the teacher. The students were asked to create their own concept maps of the topic of IICE. In this method of scoring concept maps, 1 point is assigned for valid prepositions, 5 points are assigned for each level of

hierarchy, and 10 points are for each valid cross link and 1 point for each example. The final score is the sum of all those scores.

Procedure

The study was conducted over two weeks. The class met three times per week. The materials covered were Introduction to the internal combustion engines which involves introduction to engines, their types, and nomenclature of engines, four stroke engines, two stroke engines, SI and CI engines and performance measuring parameters. Students were randomly assigned to the two groups. In the first week, experimental group was made familiar about the characteristics, usefulness and creation of concept maps as suggested by Novak and Gowin (1984). After two weeks, the experimental group was provided with the list of concepts that were generated in the class discussion and was required to submit the concept map by using the techniques taught by the teacher. The control group was taught with the traditional teaching method by the same teacher. The control group was given additional two hours of revision lectures. The concept maps generated by the experimental group were scored by using Novak's criteria. At the end of the treatment period, both the experimental and control group students took the post test on the topic of IICE at the same time.

Results

The mean score of the *pre- test* for the experimental group was found to be 16.65, while that of the control group was found to be 17.15 out of a maximum possible score of 30. A t-test for independent samples showed that there were no significant differences between the two groups ($t = 2.47$, $p > 0.05$).

Table 3 presents the means and standard deviations of the *post test* results for the control and experimental groups. These results include the scores at the knowledge level (KL), comprehension level (CL), application level (AL) questions and numerical level (NL) along with the total scores on the topic of IICE achievement post-test (TL).

 A t-test for independent samples was carried out to test whether the experimental and control groups differed significantly on the post-test achievement in the topic of IICE (TL). It is shown in Table 3. Significant differences were found at the total scores ($t = 2.19$, $p < 0.05$). In addition, a t-test for independent samples was carried out to test whether the scores of the experimental and control groups differed significantly on the questions at different cognitive levels. A significant difference was found for the questions at the knowledge level (KL) ($t = 2.33$, $p < 0.05$) and application level (AL) ($t = 4.06$, $p < 0.05$). No significant differences were found at the comprehension level ($t = -1.13$, $p > 0.05$) and the numerical level ($t = 0.515$, $p > 0.05$).

Table 3 Means and Standard Deviations of the parameters used in the study for the experimental and control groups

	Experimental group			Control group			t	p value
	N	Mean	SD	N	Mean	SD		
KL-test	64	7.17	1.83	70	6.40	1.98	2.33	0.021*
CL-test	64	5.64	1.92	70	6.08	2.55	-1.13	0.260
AL-test	64	7.17	1.50	70	5.97	1.87	4.06	0.0001*
NL-test	64	6.43	1.74	70	6.27	1.97	0.515	0.608
TL-test	64	26.42	3.89	70	24.72	4.92	2.19	0.030*

Note: p* < 0.05
KL-test = scores of knowledge level questions in the post-test (the maximum score is 10).
CL-test = scores on comprehension level questions in the post-test (maximum score is 10).
AL-test = scores of the application questions in the post-test (Maximum score is 10).
NL-Test= scores of the numerical Level questions in the post-test (Maximum score is 10).
TL-test = Total scores on the post-test (the maximum score is 40).

Correlation between scores in the topic of IICE and scores in the creation of concept map

The maps generated by the students are diverse in nature. Some maps received low scores due to the absence of cross links and some of the students received high scores due to presence of levels of hierarchy, more number of concepts, cross links and examples. The maps were inspected for the number of invalid prepositions, absence of critical concepts and links. The experimental group students' post test scores were correlated with the corresponding concept map scores constructed by the students on the topic of IICE. Results show that they are weakly correlated. (Pearson correlation coefficient = 0.16). Again the concept map scores were correlated separately on knowledge level, comprehension level, application level and numerical level scores as shown in Table 4.

Table 4 Correlation between concept map scores and the achievement post test scores of IICE.

Concept map score	KL test score	CL test score	AL test score	NL test score	TL test score
Pearson correlation coefficient	0.21	0.12	0.13	0.11	0.16

Student's perceptions towards concept mapping

To evaluate the students' attitude towards concept mapping and the use of this tool in the topic of the IICE, questionnaires were administered to the students. The students were questioned on i) the utility of concept maps to connect various concepts, ii) help in problem solving iii) as a tool for study and revision, iv) to help in recall of the concepts and v) to memorize the concepts. The reliability estimate for the questionnaire based on the Cronbach alpha method is 0.85, which is consistent with reliability estimates of perceptions questionnaires from other such studies. Most of the students were in favour for the use of the concept maps in the classroom. Nearly 88% students were in the favour of the use of concept mapping in IICE, 83 % students were of the opinion that concept mapping is useful for study and revision and 84 % students said that concept maps help them to connect various concepts.

Discussion and Implications

This study investigated and evaluated the effects of the use of concept mapping strategies on students' achievements in the field of mechanical engineering education. The results of quantitative analysis showed that the two groups did exhibit significant differences in students' achievement. Our results are consistent with the other researchers (Prince, 2004). The results show that students who are using concept maps are actively involved in knowledge creation process. This results in deeper learning. The results of

quantitative analysis using Bloom's taxonomy indicate that students using concept mapping performed better than those not using concept maps in terms of the cognitive levels of understanding of concepts and creating of concepts. One possible explanation of the result is that students using concept maps have clearer conceptual understanding, interpretation, and summarization of the topic.

Using concept maps at different Bloom's cognitive levels shows that the performance of students improves at knowledge level and application level. One possible reason is that knowledge level contains simple questions like define, recall and list. Knowledge level requires interconnectivity between concepts. Results of this study show that concept maps help students to connect concepts at knowledge level. At application level, the student's performance is improved with the use of concept maps. Concept maps help students in applying the concepts. Concept maps do not improve the performance at comprehension and numerical level. Creation of concept maps does not help in comprehending the concept and problem solving skill. Future research is needed to investigate effect of concept maps on different topics of mechanical engineering education at different cognitive levels of Bloom's taxonomy.

The correlation between the IICE scores at the total post test score, knowledge level, comprehension level, application level and numerical level scores and concept map score is weak. Concept maps evaluate aspects of learning that the conventional achievement tests cannot measure but they also assist in measuring other aspects of learning which conventional tests do no measure (Ruiz-Primo et al., 2001). The strength of the correlations depends upon three factors: the type of conventional test, the type of concept map format and the scoring rubric of the concept map (Ruiz-Primo et al., 2001). Future research is needed to explore the relationships between concept maps scores and different levels of cognitive domain of Bloom's taxonomy on different topics of mechanical engineering education.

There are certain limitations to our present study. The generalization of the findings may be limited to samples with similar nature but may not be applicable with different educational and cultural backgrounds. The conclusions of present study cannot be generalized to other subjects. Future studies need to include students' learning preferences. In summary, the present study provides evidence to support the use of concept maps in mechanical engineering education.

Conclusions

The present study investigates whether students generated concept maps benefit students in the learning of the topic of introduction to the internal combustion engines (IICE) in mechanical engineering education. Research findings indicate that students benefitted with the use of concept maps in the teaching- learning process. The positive impact of the use of concept maps was statistically significant in the learning of the topic of IICE. Furthermore, concept maps help students to arrange logical flows of ideas of concepts in a visual manner. By using concept maps in courses, a teacher can gain insight into what is learned by the students. Through the use of concept maps, a teacher can find struggling areas of the students such as supercharging, turbocharging, etc. Students' positive perception towards concept maps in the present study could also be a factor explaining the positive impact on learning. It seems evident that concept maps are a useful tool in assessing students' knowledge and knowledge organization.

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VISUALIZING CELLULAR RESPIRATION WITH AN INTERACTIVE COMPUTER PROGRAM

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Abstract

This paper describes a computer interactive program as a tutorial for beginners to learn the basic concept of cellular respiration process using C++ and OpenGL. Cellular respiration is the set of metabolic reactions and processes that take place in the cells to convert biochemical energy from nutrients such as glucose into adenosine triphosphate (ATP). The energy producing reactions, which involve three pathways (glycolysis, citric acid cycle, and electron transport system/oxidative phosphorylation), are very complicated and difficult to teach and learn. The main objective of this program is to provide spatial concept that may help students understand the complicated reactions in cellular respiration. To enhance students' visualization skills, we emphasize the interactivity of the program. At the same time, the hands-on experience may raise students' interest during the learning process. The program allows students to manually manipulate 3D models and visualize major steps of each pathway.

Keywords: cellular respiration, visualization, interactive program

I.   INTRODUCTION

Metabolism is often defined as all chemical reactions that are needed to maintain living state of a cell or an organism. We may conveniently divide metabolism into two major categories: 1) catabolism – the breakdown of large molecules to obtain energy and 2) anabolism – the synthesis of complex molecules with the input of energy. The next question is "What is energy?" Energy may be thought of as the ability to do work (causing specific changes or chemical reactions). In the living system, the most commonly used molecule for energy storage and transfer is adenosine triphosphate (ATP). The energy is stored in its phosphoanhydride bonds. When ATP is converted to adenosine diphosphate (ADP), the high energy bond is broken and the energy is released for other energy requiring reactions. Thus, ATP, a common product of catabolic reactions, is used to drive anabolic reactions, making energy currency of the cell [1-2].

Cellular respiration is a series of reactions that releases energy by oxidation of organic molecules (e.g., glucose) with the electrons eventually transferred to oxygen. If respiration takes place under the anaerobic condition, it is called fermentation. If respiration occurs under the aerobic condition, it is called aerobic respiration, which is the topic in this paper. Using eukaryotic cells (cells with nuclei such as plant and animal cells) as an example, one may divide cellular respiration into three major pathways: glycolysis, citric acid cycle, and electron transport system/oxidative phosphorylation [1-2].

We shall now review the main points of cellular respiration so that this complicated process can be visualized with our interactive computer programs.

Glycolysis: Glycolysis is a 10-step sugar splitting process where one glucose (6-carbon) is broken down into two pyruvate (3-carbon) with a net gain of 2 ATP (4 ATP are produced but 2 ATP are used in the process) and 2 NADH.

Glycolysis occurs in the cytosol, the non-member part of cytoplasm, and it does not require oxygen. However, if oxygen is present, pyruvate enters the mitochondrion to begin aerobic respiration characterized by the citric acid cycle coupled with the electron transport system/oxidative phosphorylation.

In the mitochondrion, a carbon atom is removed from pyruvate to form acetyl CoA (2-carbon) plus CO_2. Acetyl CoA is then oxidized to form the high energy molecule NADH (a reduced form of nicotinamidedinucleotide) from NAD^+. Thus, two more NADH are formed per molecule of glucose.

Citric Acid Cycle (TCA Cycle or Krebs Cycle): In the matrix of the mitochondrion, coenzyme A of the newly entered acetyl CoA is removed when the two-carbon compound is attached to a four-carbon compound oxaloacetate to form citrate (6-carbon). Each citrate molecule then undergoes a series of reaction reactions which end up with oxaloacetate, thus forming a reaction cycle each producing 2 CO_2, 3 NADH, $FADH_2$, and 1 ATP. For 2 acetyl CoA per glucose, these products are doubled: 4 CO_2, 6 NADH, and 2 ATP.

Electron Transport System/Oxidative Phosphorylation: The inner membrane of the mitochondrion is a folded structure called cristae, where electron carriers are located for the electron transport chain reaction. These carriers pass electrons from a high-energy compound to a low-energy electron acceptor. During these oxidation-reduction processes, energy is released to produce ATP. As mentioned earlier, the electron transport chain occurs in the inner membrane (cristae) of the mitochondrion. The electron transport process pumps the hydrogen ions (H^+) into the space outside the inner membrane called intermembrane space for oxidative phosphorylation.

NADH and $FADH_2$, which are products of the citric acid cycle, carry high energy electrons to the electron transport system, which contains membrane-bound electron carriers that pass electrons from one to another. During this process, some of the energy is released and used to pump hydrogen ions across the membrane into the intermembrane space. The remaining energy is used to reduce the next carrier. As this process continues, the hydrogen ions are concentrated in the intermembrane space. The energy of this osmotic gradient is then used by the enzyme ATPase to synthesize ATP as the hydrogen ions move by the enzyme back to the mitochondrial matrix.

What eventually happen to these electrons? Oxygen is the final electron acceptor. The low-energy electrons from the electron transport chain are accepted by O_2. Combined with protons from the medium, the final product is water: $2H^+ 2e^- + \frac{1}{2} O_2 \rightarrow H_2O$

Due to the complexity of the cellular respiration process briefly described above, teaching and learning of this subject at the high school and college levels have always been challenging. Many tutorials have recently been developed to help students understand the topic. These include a series of animated tutorials developed by Sumanas, Inc., explaining the concept of cellular respiration as part of the general biology program [3]. The tutorial is intuitive and easy to follow. However, the concept is only demonstrated using

animation process in a video. McGraw Hill provides a tutorial which includes animated pictures and audio [4]. The tutorial from Pearson Prentice Hall is basically an online textbook with text and animated procedure matching the context [5]. All these tutorials appear helpful and impressive for the animated part. However, without being interactive, the educational value is limited [6-8].

In order to provide a highly effective way for learning cellular respiration, we developed a tutorial program with integrated functions (interactivity and controllability) and applicability. The program aims to improve the teaching and learning of cellular respiration in the biology and health science related courses for beginning college students.

II.   METHODOLOGY

 For the safe of simplicity and clarity, the cellular respiration process is condensed in the program into 13 steps.

The program is made up of several different scenes for animation and user interaction. The animation processes are handled by both the model and the timing function. A script is assigned to each animation model according to a predefined key frame. The model's position and movement at any specific time are automatically calculated and updated in real time.

Right and left arrow keys are used to control the current scene position. The right arrow key is used to move the current scene position forward by one, and the left arrow key is used to move the current scene position back. In total, there are 15 scenes and 10 animations.

The spacebar is used to toggle the text description of the scene. The text description can be toggled on or off at any time during the tutorial period. With the text description enabled, the user can read a description of what is happening in the tutorial. Color-coded legends are provided for the user.
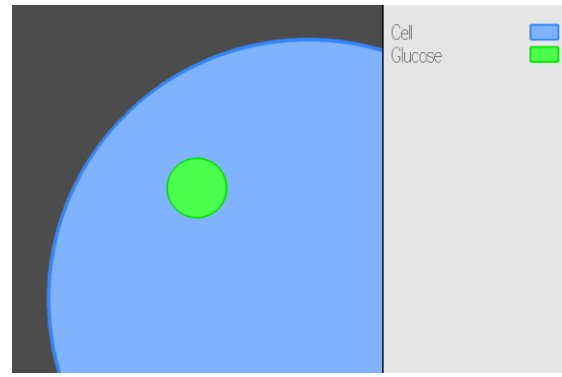
III. RESULTS

The following program has a simple design, so that it is easy to follow. Figure 1 demonstrates the simulated steps in the program of cellular respiration.
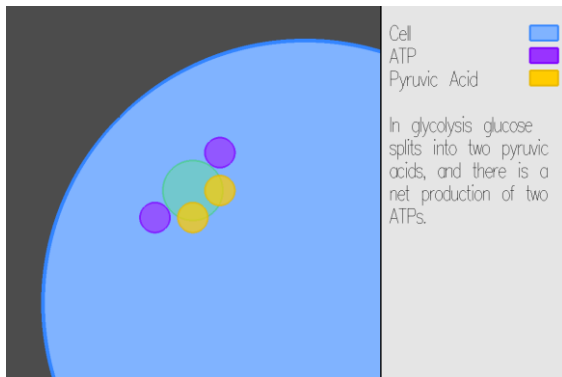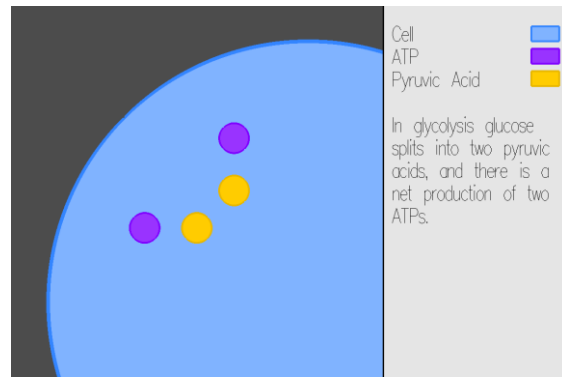

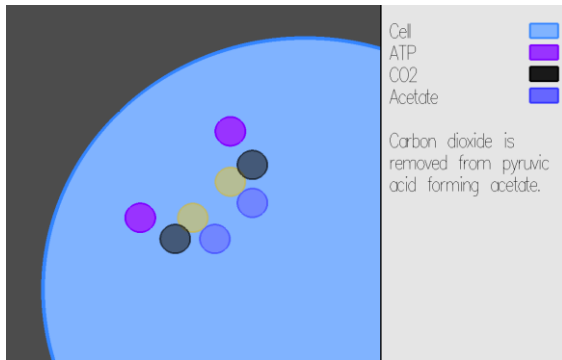Scene Position 1
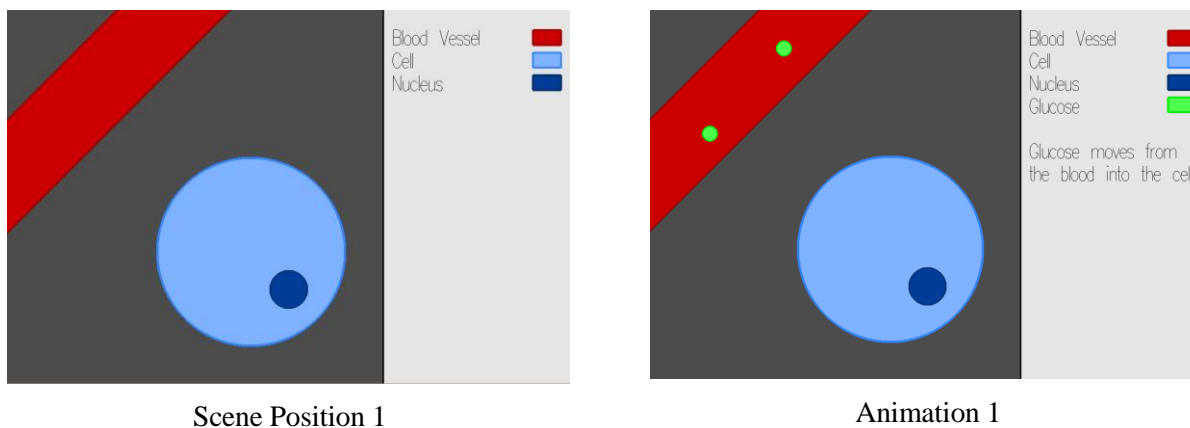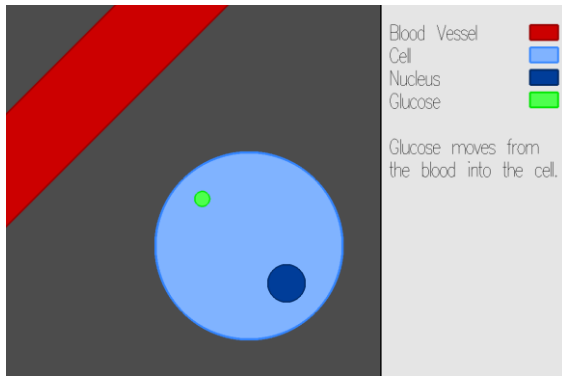
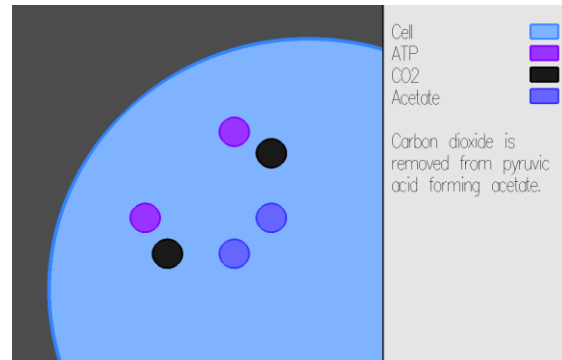Animation 1

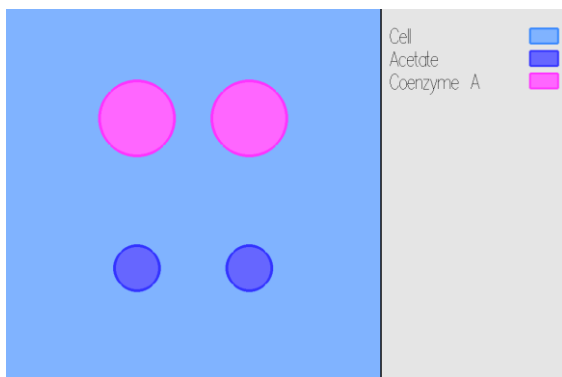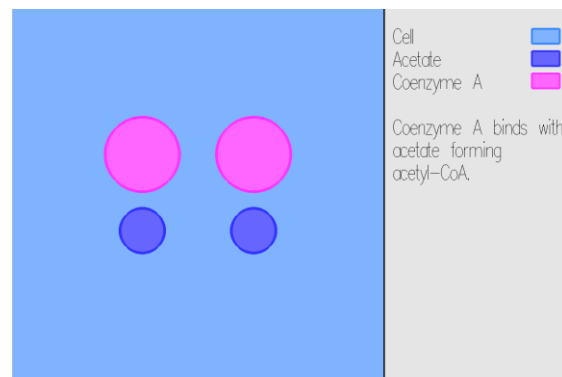Scene Position 2

Scene Position 3
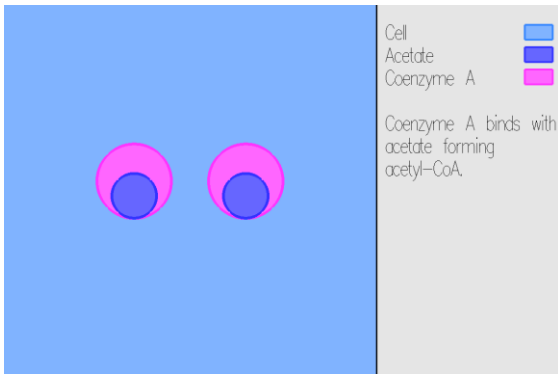

Animation 2

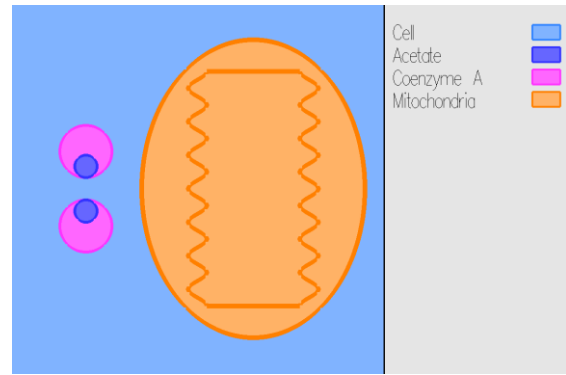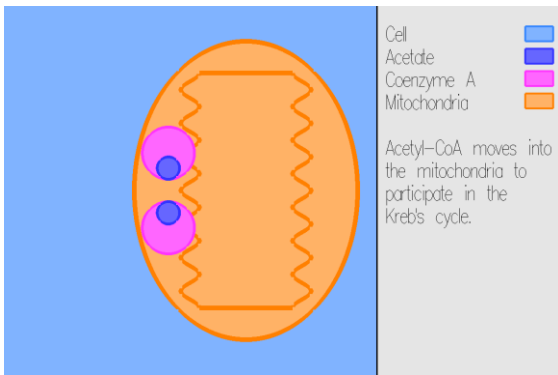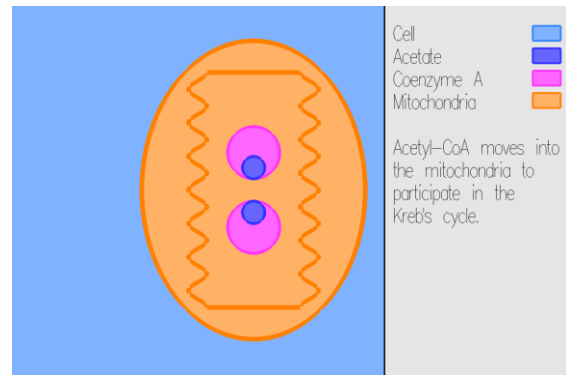Scene Position 4

Animation 3

Scene Position 5

Scene position 6

Animation 4

Scene Position 7

Scene Position 8

Animation 5

Scene Position 9
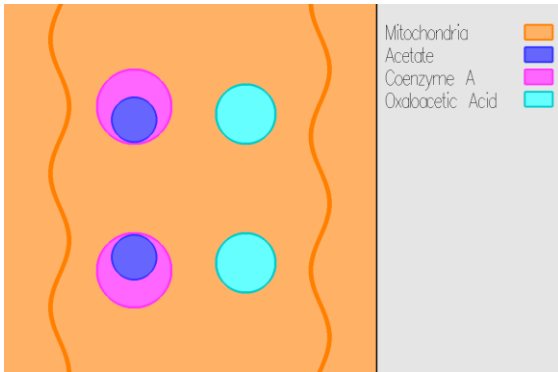
Scene Position 10
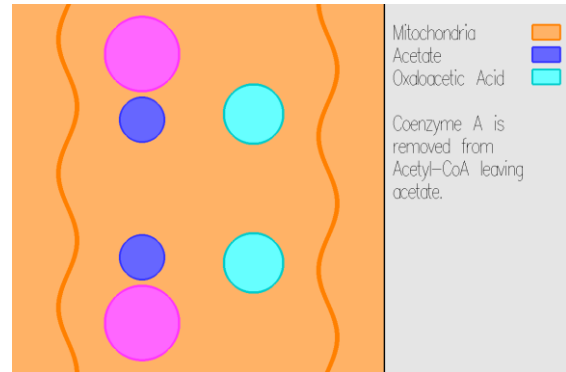
Animation 6
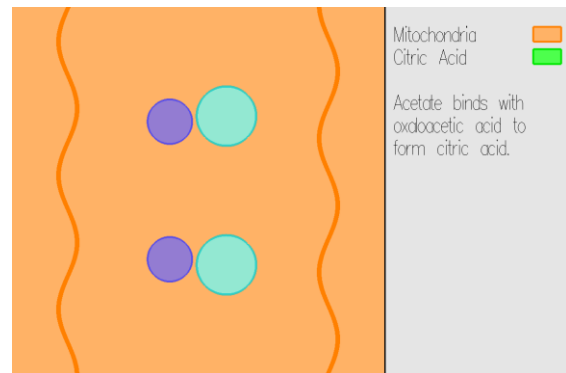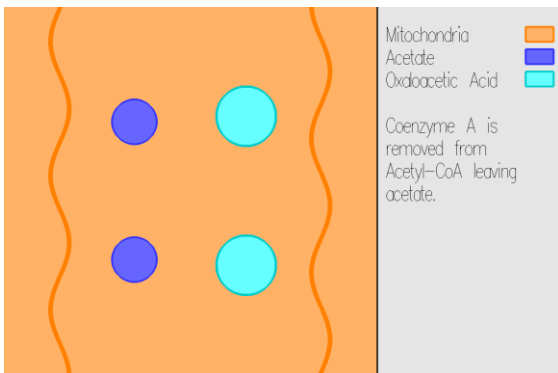
Scene Position 11

Animation 7

Mitochondria
Citric Acid

Acetate binds with oxaloacetic acid to form citric acid.

Mitochondria
Oxaloacetic Acid
Carbon Dioxide
ATP
Hydrogen Ion
Electron

Citric acid is changed back into oxaloacetic acid. Two ATPs are produced. Carbon dioxide is released. Hydrogen ions and electrons are moved to the inner membrane.
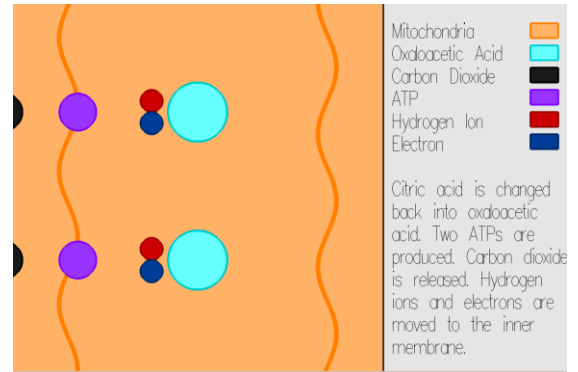
Scene Position 12

Animation 8

Mitochondria
Oxaloacetic Acid
Carbon Dioxide
ATP
Hydrogen Ion
Electron

Citric acid is changed back into oxaloacetic acid. Two ATPs are produced. Carbon dioxide is released. Hydrogen ions and electrons are moved to the inner membrane.

Mitochondria
ATP
Hydrogen Ion
Electron

In the electron transport chain, 32 ATPs are produced in the inner membrane.
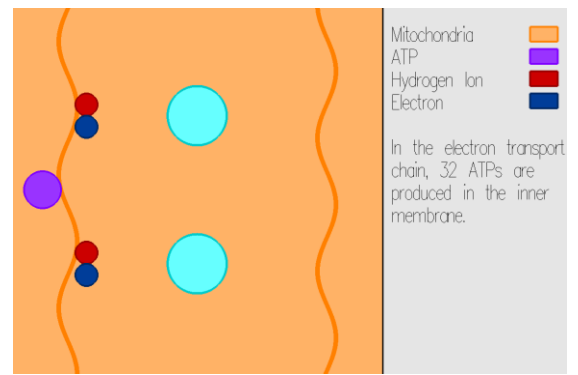
Scene Position 13

Animation 9

Mitochondria
ATP
Hydrogen Ion
Electron

In the electron transport chain, 32 ATPs are produced in the inner membrane.

Mitochondria
Oxygen
Water

Oxygen combines with hydrogen ions and electrons to form water.
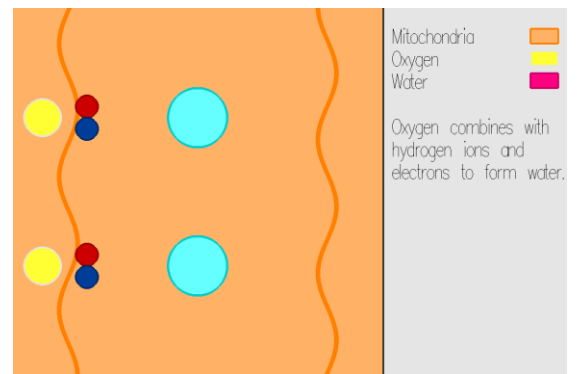
Scene Position 14

Animation 10

131
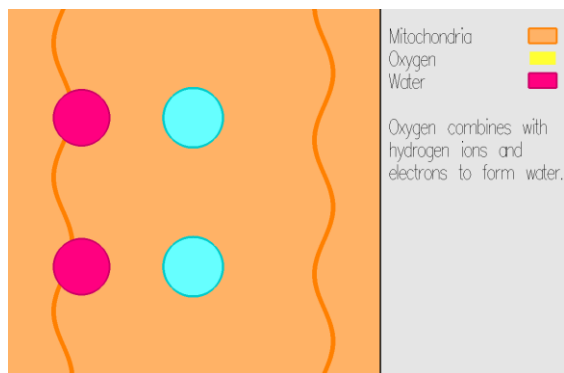
Scene Position 15

Figure 1. Screen snapshots of the cellular respiration program

CONCLUSIONS

The program developed in this paper can be used as an introductory tutorial in learning cellular respiration at the beginning college level. The simple interface is useful for anyone who is capable of using a computer. Instructors can use this tutorial as a visual aid in the classroom setting. Students can use the tutorial by themselves to review the material as well as for self-learning. If the usefulness of this interactive program is verified, a more detailed program will be developed for learning cellular respiration at the advanced level. This program may also serve as a model for developing tutorials for other biochemical reactions.

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TEACHER-STUDENT RELATIONSHIPS

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Abstract

In the present scenario where the classrooms are considered a complex social system, the teacher-student relationships are also equally complicated. For creating a strong discipline system and for the healthy development of all students in schools strong and supportive relationships between teachers and students are the basic requirements. Positive teacher-student relationship is one of the most effective weapons to foster a healthy and learning climate in the classroom. Not only does this contribute to a positive classroom environment, but it also improves the quality of school life for both teachers and their students. The aim of this research is to investigate how a supportive relationship between teachers and students in the classroom can ameliorate the learning process. By having a fruitful relationship with students, teachers can offer to students chances to be motivated and feel engaged in the learning process as they will be engaged actively in the learning instead of being passive learners. I wish to investigate how using communicative approach and cooperative learning strategies while teaching do affect and improve students' learning performance. The paper also presents some qualitative data collection which was used as the primary method and results show that teachers and students value a supportive and caring relationship between them and that interaction is essential to the teacher-student relationship. This sense of caring and supporting from teachers motivates students to become a more interested learner. Also sizable literature provides evidence that strong and supportive relationships between teachers and students are fundamental to the healthy development of all students in schools. As such, student–teacher relationships provide a unique entry point for educators and others working to improve the social and learning environments of schools and classrooms.

Keywords: Teacher, Student, Relationship, Learning.

Introduction

The relationship between teacher and student has been a matter of discussion for over 2000 years, since Plato, Socrates, and Confucius established much of the philosophical guidelines for teaching.

The recent century has witnessed the development of ideas fostering teacher-student relationships. Students' relationships and interactions with teachers are often considered to have a major influence on the mental, social and communicable aspect of student's career. The extent to which the teacher engages the students into fruitful discussions can be pivotal in shaping the relationship. In this sense, relationships between teachers and students reflect a classroom's capacity to promote development, and it is precisely in this way that relationships and interactions are the key to understanding engagement.

Teaching is considered as a challenging activity in our society wherein the students are taught certain social skill sets, knowledge and abilities which make the environment around them seem congenial and they are able to integrate themselves in the community. The most essential part of teaching involves a strong communication between the teacher and students and also among other students. Also, a supportive teacher is one who creates efficiently a positive classroom environment, who encourages students to behave well in classroom and to be motivated. Hence, the orthodox ways of teaching need to be avoided by the teachers of today's generation since the traditional way involves teaching method to methods and strategies whereas the need of present is to promote an engaging and interactive discussion of content and queries in the classroom. Therefore, it is time to change to a

method that guarantees communication and interaction between teacher and students and promote a supportive relationship between them.

This sense of caring and supporting from teachers motivates students to become a more interested and avid learner. A good communication, engaging discussions and understanding quintessentially represent an effective teaching and more supportive classroom environment thus encouraging and motivation students to take part in the class and get involved into the content rather than just cramming it up in order to get promotion to a higher standard class.

Research Methodology

In order to achieve the proposed objectives of this research paper the qualitative data was collected which consists of general, emerging questions related to teacher and student behavior in the classroom. In order to gather this data, a group of 50 post graduate students were selected randomly along with the post graduate teachers of these students. Students were chosen from different classes and also from different cultural backgrounds in order to reach valid and authentic results. These participants were asked to complete a questionnaire on teacher student relationship in the classroom. Age and class subject were completely disregarded in the selection of students as an equitable distribution of male and female participants were chosen. The purpose of this question survey was to gauge the teachers' and students' opinions about how a supportive relationship between teachers and students in the classroom can improve the learning process, and how communicative approach and cooperative learning strategies while teaching do affect and improve students' learning performance.

Review of literature

In the present scenario, teaching brings out a pool of challenges and opportunities. An optimistic teacher-student relationship can be the key to success for a student because of its influence on the attitude of a learner's motivation and understanding.

According to Hargreaves (1994), "Good teaching is charged with positive emotion. It is not just a matter of knowing one's subject, being efficient, having correct competencies, or learning all the right techniques. Good teachers are not just well oiled machines. They are emotional, passionate beings who connect with their students and fill their work and classes with pleasure, creativity, challenge and joy."

According to Davis (2003), "Operating as socializing agents, teachers can influence students' social and intellectual experiences via their abilities to instill values in children such as the motivation to learn; by providing classroom contexts that stimulate students' motivation and learning; by addressing students' need to belong; and by serving a regulatory function for the development of emotional, behavioral, and academic skills. Moreover, supportive relationships with teachers may play an important developmental role during the transition to and through middle school. However, developing relationships with an early adolescent presents unique challenges to middle school teachers."

Koplow (2002) proposed that effective student teacher relationships encourage greater confidence and classroom engagement in much the same manner as sensitive parenting encourages a greater sense of security and confidence. Students need the confidence and motivation to learn, which can be stimulated by the relationship they hold with their teachers. Students also perform well when they feel that the teacher is passionate about what they are teaching and pass security and confidence to the students. When teachers believes in students' ability to succeed it motivates them because students don't want to let them down but it also makes students believe that they are more capable than they even imagined.

Macpherson (2007) also states that Cooperative Learning models include the following basic principles: First, group tasks are designed to be suitable for group work. Second, positive interdependence is built in – cooperation is necessary for students to succeed. Third, attention and class time are given to interpersonal/cooperative skill building. Fourth, participants learn together in small (2-5 members) groups. Fifth, students are individually accountable for learning and participation. And finally, the instructor's role changes from being the "sage on the stage" to the "guide on the side."

Instrument 1- Student surveys

To infer about the relationship that exists between students and teachers, the following question was asked:

Q. How is your relationship with your teacher?

In response, 50% of students indicated that they have a good relationship with their teacher and only 38% responded to a very good relationship. On the contrary, 8% ticked the sufficient mark and about 3% of students indicated that it needs improvement. However 1% of students indicated that the relationship was not good.

In terms of motivation by having a caring teacher, this question was asked:

Q. Do you feel motivated by having a teacher who cares about their students?

The answers recorded for this question were quite amazing and immensely satisfying as 91% agreed that they always feel motivated by having a teacher that care about them. With only 9% of students providing the 'often motivating' response there was not even a single student who indicated 'sometimes', 'rarely' or 'never' on the questionnaire.

As for the importance of the relationship students maintain with teachers, the following question was asked:

Q. How important is to have the relationship you maintain with your teacher to classroom interaction?

In response, 73% of the students indicated that it is very important to maintain a good relationship to have a fruitful class discussion. Students also commented that they felt more comfortable in classroom due to the relationship they maintain with teachers. Only 13% answered the 'strong' response and 14% said 'somewhat strong'. Hence, overall the responses revealed optimistic and positive results on maintaining the relationship.

Regarding how students see their teachers, the following question was asked:

Q. Do you feel your teacher is a cooperating teacher?

Of students surveyed, 65% claimed that their teachers are 'always' cooperative. Student's survey reported that teachers always try to engage and help all students inside the classroom. 26% of students stated that their teacher is 'often' cooperating whereas only 9% indicated that the teachers are 'sometimes' cooperative without any student providing a negative response.

As for how comfortable they feel using communicative language teaching, the following question was asked:

Q. Do you feel comfortable of having a teacher that uses the communicative language teaching methods and cooperative learning strategies?

About 71% of the students indicated that they 'always' felt more comfortable and motivated to participate in the class due to their teacher's adopted set of strategies. Also, 25% of students said that they

'often' feel comfortable by the method of communicative and cooperative learning and only 4% indicated that they 'sometimes' feel good by these new teaching techniques. Overall, a well-rounded positive result was yielded supporting the newly adopted learning techniques.

Instrument II- Teacher Surveys

Teacher's foster positive relationships with their students create classroom environments more conducive to learning and meet students' developmental, emotional and academic needs. Here are some concrete examples of closeness between a teacher and a student:

Regarding the relationship teachers hold with students, the following question was asked:

Q. Do you hold supportive relationships with your students?
        Amongst the teachers surveyed 86% indicated that they always try to hold a supportive and optimistic relationship with their students. Only 14% indicated that they 'often' have a supportive relationship whereas none of them ticked 'sometimes, rarely or never'. A teacher pointed that: it is my role as a teacher to be supportive with my students. It is important for them to grow academically.

Regarding teachers' awareness of their students' needs, the following question was asked:

Q. Are you emotionally aware and sensitive to the needs of students?
        The responses for this question were quite scattered. About 57% of the respondents said that they are 'always' emotionally aware of their students and sensitive need of their students. Another 29% said that they are 'often' aware whereas 14% said that they are 'sometimes' aware of the needs. The possible reason for this dispersed result as stated by the teachers was the diversity of students who have different backgrounds and hence bring different issues to the class.

 Talking about interaction, the following question was asked:

Q. Are you able to interact with students in a calming manner and let students feel engaged in the learning process?
        The scattering trend continued in these responses as well. According to 57% of the teachers surveyed, they 'always' interact with their students in a calm manner and make them feel engaged in the learning process. Another 27% indicated that they 'often' interact in a calming manner and 14% said that they 'sometimes' interact in a calming and engaging manner. One of the main reasons for this response according to teachers is too much leniency can sometimes be troublesome and hence teachers need to assert their seniority and authority.

In relation to teachers' beliefs in students' ability, the following question was asked:

Q. Do you believe in students' ability to succeed when they have a supportive teacher?
        The responses of this question are contrary to the last couple of questions asked. The monopoly of teachers, about 86%, indicated that they always believe in students' ability to succeed when they have a supportive teacher. Only 14% said that they 'often' believe in their students' ability. Teachers shared a common view that a supportive teacher is always able to encourage students to perform better.

Talking about the importance of teaching communicative English to students, the following question was asked:

Q. How important do you think it is to teach communicative English to your students?

The results expected were not found as a slightly less number of teachers gave English the top priority. Results from the surveys show that 66% of the teachers surveyed think that it is always important to teach communicative English to students. However, 17% indicated that it is 'often' or 'sometimes' important to teach communicative English.

Result

The survey conducted here has been successfully able to corroborate for the fact that a 'positive', 'communicative', and 'engaging' student-teacher relationship is crucial in shaping the development of students and their careers. Findings from the surveys show that the majority of teachers and students value a supportive and caring relationship between them and that interaction is essential to the teacher-student relationship. This sense of caring and supporting from teachers motivates students to become a more interested learner. A caring teacher will help students to overcome struggles. However, still a few people have provided negative responses as to whether this communicative learning is effective or not. The reason might be the incorrect implementation of these techniques by both teachers and students. But still there is a lot to work upon as there is always a room for improvement.

Suggestions

For fostering a favorable learning climate in the classroom and developing positive teacher-student relations, there are some powerful weapons of teaching which can be implemented in everyday interaction with the students as follows:

Communicating Positive Expectations

Research on teacher expectations and student achievement has shown that expectations have a dramatic impact on student academic performance. In order to achieve this goal there are several techniques that can be used such as call on each student equitably, increase latency periods when questioning student, deliver hints and clues while trying to solve the questions, encourage students to perform well.

A teacher should always make sure that for equitable discussion he/she gives indiscriminate chances to all students. But there are several things to keep in mind while calling on students for discussion. Often, teachers give chances to few students and ignore those students from whom they have low expectations of getting an answer. By doing so a teacher always loses the confidence of students in their abilities and they think that they will not be able to answer any question. Therefore, it is important for a teacher that equal response opportunities are provided to all the students and always make sure that only high-achieving students are not called exclusively but also those students that are not performing well. Hence, through this strategy a teacher will help students to develop feelings of self-confidence in their abilities and decrease the number of behavior problems. Over time, teachers will notice that these students will remain on task more often and improve academically. Of course this change does not occur overnight, but it definitely does occur and is extremely gratifying to see.

Increasing latency is another technique that can be used by the teachers to communicate which shows positive expectations from a student. Latency is the amount of time that a teacher gives a student to answer questions which are directly related to the expectation of a teacher from his/her students. The time which is given to the students to come up with right answer also reflects the level of confidence of a teacher in their ability. When a teacher wants quick response against his/her question from a student who is struggling to come up with the right response it means that the teacher is not having enough confidence in his/her ability. Therefore, it is necessary to pay more attention to low-achieving students and always involve them effectively in discussion until you move on to another student.

A teacher should always communicate positive expectations by giving hints and clues to their students especially the low-performing students in their work. But while using this technique some cautions should be taken by teachers such as not provide too many hints and clues because in this way a teacher actually give the answer to the student. Also, after a number of hints, it may be that the only student who doesn't know the answer is the one being called on, which ends up being an embarrassing experience. The important point, however, is to use hints and clues with all students to communicate that you have high expectations for the entire class. This helps build positive teacher-student relations.

Correcting Students in an Optimistic Way

There might be instances when students indulge in inappropriate activities and hence it becomes necessary for a teacher to build a positive relationship while correcting them. The goal in correcting students should be to have them reflect on what they did, be sorry that they disappointed, and make a better choice in the future. The degree of punishment and showcasing of authority needs to be limited as too many restrictions on students might be troublesome. Hence, a teacher needs to develop a student by correcting his mistakes in a constructive and optimistic way. The correction process will be counterproductive if students are corrected in a manner that communicates bitterness, sarcasm, low expectations, or disgust.

Showing Sympathy and Care for Students

An important aspect of developing a positive relationship with students is to care about their needs.). When actions and words communicate that a teacher sincerely cares for his/her students, they are more likely to want to perform well and enjoy coming to school. Caring is also indirectly associated with complying as students who are cared for by their teachers are often ready to comply with their teachers' policies without much resistance. This aspect, if not taken care of, can prove to be fatal for the student-teacher relationship as students who feel that they are not cared much by their teachers can often be de-motivated and hence end up finding themselves in a deep mental and academic pitfall.

Reducing Frustration and Stress

Certain aspects of teaching bring some inevitable agonies to a teacher in the form of frustration and stress. One of the main reasons for this stress is the feeling of failure from difficult and challenging students whose performances are sometimes near to impossible to improve. It is very essential to de-escalate this frustration as it may tarnish the positive relationship that the teacher has built with a student. No one set of techniques may suit every teacher to lower his/her stress levels and hence it is important on every teacher's part to develop some unique and suitable techniques to avoid stress.

Conclusion

In a nutshell, fostering a positive student-teacher relationship is pivotal in order to promote a healthy education system as well as to provide the students with a positive congenial environment. When teachers hold a positive relationship with students, they certainly impact students' interests in school and therefore their level of achievement. Findings from the surveys showed that teachers feel that when they know their students, and they hold a good relationship with them, students are more focused and work harder and thus they can better achieve their goals. Hence, interaction with the students not only improves and develops a student's performance but also satiates the heart of a teacher with a feeling that he/she has been able to improve a student and direct him towards a better future.

"Treat a child as though he already is the person he's capable of becoming"
-Haim Ginott

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CONSTRUCT AND ASSESS EMOTIONAL COMPETENCY FOR TAIWANESE YOUNG CHILDREN

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Abstract

Emotion has been one of the six curriculum areas in Taiwan since August 30, 2012. However, few studies have examined the development and assessment of young Taiwanese children's emotional competency. This study developed a scale, called the Emotional Competency Rating Scale for Young Children (ECRSYC) in Taiwan, and analyzed the developmental norms of these children. The study adopted a cross-sectional approach and selected 1200 children aged 4–6 years by using stratified random sampling. Data analysis methods included principal component analysis, descriptive analysis, t testing, ANOVA analysis, Post hoc comparisons, and multiple regression analysis. Four factors comprising a total of 40 competencies were identified: understanding one's emotions, understanding others' emotions, adjusting one's emotions, and inspiring oneself. The results revealed which children were most familiar with their own emotions. Girls were significantly more adept than boys across the four subscales. Older children's emotional competency was significantly greater than that of younger children. Children in Central Taiwan were significantly more understanding of others' emotions and were the most adept at inspiring themselves. Age and gender were predictive factors. In conclusion, the ECRSYC exhibited high validity and reliability. The practical implications of this study are in helping teachers evaluate children's emotions. A follow-up study will develop an alternative instrument with which children's emotions can be measured by examining how they manipulate e-blocks (i.e., SIFTEO cubes).

Introduction

The significance of the present study

Wei (2007) found that a person tends not to have impulsive behavior when one is aware of one's emotion and uses adequate emotional expression and adjustment. Wei (2007) argued that providing timely assistance and counselling in accordance with children's development of emotional competence can help them develop emotional competence smoothly. Related studies are rare on analyzing children's emotional competence with a standardized scale. Educational personnel have few empirical studies to know whether the emotional competence development of children in Taiwan differs according to various demographic variables as well as the relationship between the variables. The study adopted a cross-sectional approach and selected 1200 children aged 4–6 years by using stratified random sampling. The ultimate goals are to develop the ECRSYC and to analyze the developmental norms of these children.

Emotional intelligence

Salovey and Mayer (1990) defined emotional intelligence (EI) as individual people's ability to be aware of their and other people's emotion and to further cope with and use the emotion to facilitate their thinking and action. Goleman (1998) proposed an intelligence framework encompassing various emotional competences, which were divided into two categories, namely personal competence involving self-awareness, self-regulation, and inspiring oneself and social competence involving empathy and social skills. Accordingly, EI signifies individual people's awareness of their and other people's emotion and their capacity to adequately regulate and manage emotion. Mayer and Salovey (1997) examined the theoretical framework proposed in 1990 and found that EI only focuses on the perception and adjustment of emotion. Thus, they proposed new definition that EI comprises the capabilities to express, understand, and adjust emotion. Weisinger (1998) contended that EI leads people's thinking and behavior and

facilitates personal development and interaction with others. In short, proper emotion management helps individual people to solve daily-life problems timely. People with high EI are able to inspire themselves and others, manage interpersonal relationship, solve confrontation and conflict, and further enhance their thinking ability.

Measurement framework of emotional competence

The measurement framework of emotional competence for young children covers four aspects of emotional competence i.e. understanding one's emotions, understanding others' emotions, expressing one's emotions, and adjusting one's emotions (Hyson, 2003). It is similar to that used by De Beauport and Diaz (1996), Fukunishi and Wise (2006), Rieffe et al. (2007), Wang (1998), Chen and Hsieh (2007), and Hsieh (2008) to measure young children's emotional management competence. For pilot study, the framework for measuring children's emotional competence development comprised six aspects, namely understanding one's emotions, understanding others' emotions, expressing one's emotions, adjusting one's emotions, interpersonal relationship management, and inspiring oneself.

Method and Materials

Pilot Study

This study performed a pilot study on emotional competence with 240 children aged 4–6 years selected by stratified random sampling in Taipei City and New Taipei City. The questionnaire comprised six subscales with 72 items using five-point Likert scale. Teachers selected the proficiency level of emotional competence for each child.

Factor analysis

Factor analysis was conducted using SPSS/15.0 for windows according to the result of the pilot study. Principal component analysis was performed, followed by orthogonal rotation using varimax; items with low commonalities were eliminated, and common factors were extracted. Regarding the result of factor analysis, the Kaiser-Meyer-Olkin measure of sampling adequacy (KMO) was 0.951; the cumulative explained variance for the four extracted principal components was 70.128%. Finally, four factors comprising a total of 40 competencies were identified: understanding one's emotions, understanding others' emotions, adjusting one's emotions, and inspiring oneself.

Reliability analysis

The Cronbach α for four subscales was 0.94, 0.95, 0.93, and 0.95. The Cronbach α for the whole scale was 0.98 that indicates high internal consistency. Overall, the ECRSYC exhibited high validity and reliability.

Nationwide stratified random sampling

For generalization, the study adopted a cross-sectional approach by using nationwide stratified random sampling. An ideal sample size was calculated by the following equation under the confidence level of 95% with ± 3% margin of error (Saunders, Lewis and Thornhill, 2008; Hung and Hsieh, 2002):

$$P = .5; N = 407,838; \alpha = .025; d = .03; z_{.025} = 1.96$$
$$n \geqq 1.96^2 \times N \times P(1-P) / \left[(N-1) \times .03^2 + 1.96^2 \times P(1-P) \right]$$

Consequently, the ideal and effective sample size was 1064. To consider the invalid questionnaires, this study selected 1200 children aged 4–6 years across country.

Results

This section presents the empirical analysis result to determine the differences of emotional competence among young children with various demographic variables and the prediction of emotional

competence from the demographic variables. This study delivered 1200 questionnaires and retrieved 1196 ones; the response rate was 99.67%. The number of valid questionnaires was 1070, the response rate of which was 89.17%.

Developmental norm of emotional competence for children aged 4–6 years in Taiwan

The average age of emotional competency was between 4.9 and 5.3 in four subscales. The results revealed which children were most familiar with their own emotions. Girls were significantly more adept than boys across the four subscales. Older children's emotional competency was significantly greater than that of younger children. Children in Central Taiwan were significantly more understanding of others' emotions and were the most adept at inspiring themselves. Age and gender were predictive factors.

Differences of emotional competence between children with different genders

This study conducted t-test and found that girls and boys were significantly different in understanding one's emotions, understanding others' emotions, adjusting one's emotions, and inspiring oneself. Girls had significant higher scores in all of four aspects than boys; the *t* values were at the level of significance of .05, .01, and .001.

Differences of emotional competence among children with various ages

ANOVA and multiple comparisons were performed on children with various ages. The research outcome found that the scores for all of four aspects significantly differed among children in dissimilar age groups. Subsequently, Scheffe's method was adopted for post-hoc comparison, and the result was as Table 1.

Table 1. Differences of emotional competence among children in various age groups

Aspect	Age groups	N	M	SD	ANOVA					Post-hoc comparison (Scheffe')
					Source of variation	Sum of square of deviation from the mean (SS)	Degree of freedom (df)	Mean square	F	
understanding one's emotions	(1)4−4.5 years	238	3.84	.76	Between	36.13	3	12.04	19.22***	(4) > (1)
	(2)4.5−5 years	257	3.99	.87	Within	667.98	1066	.63		(4) > (2)
	(3)5−5.5 years	286	4.02	.79	Total	704.12	1069			(4) > (3)
	(4)5.5−6 years	289	4.34	.75						
understanding others' emotions	(1)4−4.5 years	238	3.57	.90	Between	61.38	3	20.46	25.95***	(4) > (3) > (1)
	(2)4.5−5 years	257	3.77	.96	Within	840.52	1066	.79		(4) > (2)
	(3)5−5.5 years	286	3.81	.90	Total	901.90	1069			
	(4)5.5−6 years	289	4.22	.79						
adjusting one's emotions	(1)4−4.5 years	238	3.42	.79	Between	72.55	3	24.18	39.54***	(3) > (2)
	(2)4.5−5 years	257	3.60	.84	Within	651.88	1066	.61		(4) > (1)
	(3)5−5.5 years	286	3.82	.75	Total	724.42	1069			(4) > (2)
	(4)5.5−6 years	289	4.12	.75						(4) > (3) > (1)
inspiring oneself	(1)4−4.5 years	238	3.50	.88	Between	48.03	3	16.01	19.47***	(4) > (1)
	(2)4.5−5 years	257	3.78	.94	Within	876.80	1066	.82		(4) > (2) > (1)
	(3)5−5.5 years	286	3.67	.96	Total	924.83	1069			(4) > (3)
	(4)5.5−6 years	289	4.08	.85						
Total scale	(1)4−4.5 years	238	3.58	.74	Between	51.84	3	17.28	29.89***	(4) > (1)
	(2)4.5−5 years	257	3.78	.82	Within	616.17	1066	.58		(4) > (2) > (1)
	(3)5−5.5 years	286	3.83	.77	Total	668.00	1069			(4) > (3) > (1)
	(4)5.5−6 years	289	4.19	.71						

*** $p < .001$

Children aged 5.5−6 years had a significantly higher score of understanding one's emotions than other three age groups. Regarding the aspect of understanding others' emotions, children aged 5−5.5 years had a significantly higher score than those aged 4−4.5 years, and those aged 5.5−6 years had a significantly higher score than those in other age groups. Regarding the aspect of adjusting one's emotions, the score for children aged 5−5.5 years was significantly higher than that for children aged 4−4.5 years and 4.5−5 years; those aged 5.5−6 years had a significantly higher score than those in other age groups. Moreover, children aged 4.5−5 years had a significantly higher score of inspiring oneself than those aged 4−4.5 years, and similarly, the score for children aged 5.5−6 years was significantly higher than that for those in other age groups. In the total scale, the scores for children aged 4.5−5 years and 5−5.5 years were significantly higher than that for children aged 4−4.5 years; children aged 5.5−6 years had a significantly higher score than those in other age groups.

Differences of emotional competence among children in dissimilar regions

ANOVA and multiple comparisons were performed on children in various regions. According to the research outcome, children in various regions had significantly different scores on two aspects of understanding others' emotions and inspiring oneself. Scheffe's method was then adopted for post-hoc comparison. The result showed that children in Central Taiwan were significantly more understanding of others' emotions and were the most adept at inspiring themselves.

Regression analysis of emotional competence of children with various demographic variables

This study analyzed the predictive power of demographic variables for the aspect of understanding one's emotions. According to the research outcome, children's demographic variables significantly predicted children's ability of understanding one's emotions as Table 2 (F = 10.29; $p < .001$). The t values show that variables of gender 1, age 1, age 2, and age 3 achieved the level of significance. Specifically, the dummy variable of gender 1 (male/female) was significant ($p < .05$); girls had a significantly higher score of understanding one's emotions than boys. The dummy variables of age 1 (4−4.5 years/4.5−5 years), age 2 (4−4.5 years /5−5.5 years), and age 3 (4−4.5 years /5.5−6 years) also had significant difference in understanding one's emotions ($p < .05$, $p < .01$, $p < .001$). Children aged 4.5−5, 5−5.5, and 5.5−6 years had a significantly higher score of understanding one's emotions than children aged 4−4.5.

Table 2. Multiple regression analysis of demographic variables on the competence of understanding one's emotions

Variable	Correlation coefficient (R)	Coefficient of determination(R²)	Unstandardized coefficients (B)	Standardized coefficient (β)	t	Intercept	F
Total scale	.25	.06			61.88***	3.77	10.29***
Gender 1 (male/female)			.119	.073	2.46*		
Age 1 (4−4.5 years/4.5−5 years)			.140	.074	1.98*		
Age 2 (4−4.5 years/5−5.5 years)			.182	.099	2.63**		
Age 3 (4−4.5 years/5.5−6 years)			.500	.274	7.24***		
Region 1 (northern/central)			.104	.058	1.80		
Region 2 (northern/southern)			-.088	-.043	-1.36		
Region 3 (northern/eastern)			-.004	-.001	-.04		

* $p < .05$ ** $p < .01$ *** $p < .001$

The predictive ability of the demographic variables for the aspect of understanding of others' emotions was examined. The demographic variables had significant predictive effect on children's

emotional competence of understanding of others' emotions (F = 14.44; *p* < .001). The t values indicate that variables of gender 1, age 1, age 2, age 3, and region 1 (north/central) all achieved the level of significance. Specifically, girls had a significantly higher score of understanding of others' emotions than boys (*p* < .01). Concerning the dummy variables of age 1 (4−4.5 years/4.5−5 years), age 2 (4−4.5 years/5−5.5 years), and age 3 (4−4.5 years/5.5−6 years), children aged 4.5−5, 5−5.5, and 5.5−6 years had a significantly higher score of understanding other people's emotion than children aged 4−4.5 years (*p* < .05, *p* < .01, *p* < .001). The dummy variable of region 1 was also significant (*p* < .01); children in central region had a significantly higher score of understanding other people's emotion than children in the northern region.

The predictive ability of the demographic variables for the aspect of adjusting one's emotions was examined. The demographic variables had significant predictive effect on children's competence of adjusting one's emotions (F = 20.21; *p* < .001). The t values indicate that variables of gender 1, age 1, age 2, and age 3 all achieved the level of significance. Specifically, regarding gender 1 (male/female), girls had a significantly higher score of adjusting one's emotions than boys (*p* < .001). Concerning age 1 (4−4.5 years /4.5−5 years), age 2 (4−4.5 years /5−5.5 years), and age 3 (4−4.5 years /5.5−6 years), children aged 4.5−5, 5−5.5, and 5.5−6 years had a significantly higher score of adjusting one's emotions than children aged 4−4.5 years (*p* < .05, *p* < .001).

The predictive ability of the demographic variables for the aspect of inspiring oneself was analyzed. The demographic variables had significant predictive effect on children's emotional competence of inspiring oneself (F = 10.78; *p* < .001). The t values indicate that variables of gender 1, age 1, age 2, age 3, and region 1 all achieved the level of significance. Regarding gender 1 (male/female), girls had a significantly higher score of inspiring oneself than boys (*p* < .01). Concerning age 1 (4−4.5 years /4.5−5 years), age 2 (4−4.5 years /5−5.5 years), and age 3 (4−4.5 years /5.5−6 years), children aged 4.5−5, 5−5.5, and 5.5−6 years had a significantly higher score of inspiring oneself than children aged 4−4.5 years (*p* < .05, *p* < .01, *p* < .001). Finally, the variable of region 1 was also significant; children in the Central Taiwan had a significantly higher score of inspiring oneself than children in the Northern Taiwan (*p* < .01).

Discussion

Contributions to promoting EI
The existing domestic and international studies have not provided a standardized tool to assess 4–6-year-old children's emotional competence (Hsu, Liao and Yu, 2005). This study developed the standardized ECRSYC for children aged 4−6 years with satisfactory reliability and validity. It can solve such deficiency and prepare children's disadvantaged emotional competence for advantages EI (Gardner, 1983).

Gender differences
Both t-test and multiple regression analysis revealed that girls were significantly more adept than boys across the four subscales. Generally, girls are relatively gentle and careful and tend to calm their mind and be empathetic to other's feelings; instead, boys are relatively active and outgoing (Hyson, 2006). Therefore, girls tend to have stable development of emotional competence.

Age differences
Children in various age groups had significantly different scores in all aspects of emotional competence. The post hoc comparisons were performed using Scheffe's method, and the result showed that children in the oldest age group (5.5−6 years) were significantly more proficient at understanding one's emotions, understanding others' emotions, adjusting one's emotions, and inspiring oneself than children at younger ages. By comparison, children in the youngest age group (4−4.5 years) had

significantly lower level of proficiency in emotional competence than older children. Consequently, children's development of emotional competence became greater with their ages increasing. This result can reflect to the previous related study (Wei, 2007).

Region differences

The differential analysis revealed that children in dissimilar regions had significantly different scores of understanding others' emotions and inspiring oneself. The post-hoc comparison conducted using Scheffe's method showed that children in Central Taiwan were significantly more proficient at understanding others' emotions and inspiring oneself than those in the Northern Taiwan. Moreover, the level of proficiency in understanding others' emotions and inspiring oneself for children in the Northern Taiwan was lower than that for children in other regions, and in particular, was significantly lower than that for children in the Central Taiwan. This is possibly because in Northern Taiwan, most parents are busy with work and spend less time on interacting with their children; thus, children in the Northern Taiwan had fewer opportunities to learn, resulting in their weak ability of understanding others' emotions than children in other regions. Additionally, children in the Northern Taiwan mostly have a relatively wealthy life; their parents have arranged all daily life matters properly. In other words, they have few opportunities to experience frustrations. Thus, compared with children in other regions, they had relatively weak inspiring oneself ability.

The emotional competence of 4−6-year-old children in Taiwan fluctuated

This study constructed a developmental norm of young children's emotional competence according to the result of emotional competence assessment conducted on 1070 children aged 4−6 years in Taiwan. The children were categorized according to gender (male and female) and age (4−4.5, 4.5−5, 5−5.5, and 5.5−6 years). The result revealed that regardless of gender difference, children's emotional competence increased as their age increased. However, the average age of boys who were "very un-proficient" and "un-proficient" at adjusting one's emotions was 4.9 and 4.8 years old, respectively. Additionally, the average age of girls who were "very un-proficient" and "un-proficient" at understanding one's emotions was 5.0 and 4.9 years old, respectively. Therefore, although in general 4−6-year-old children's emotional competence increased with their age, the level of emotional competence was still unstable and may be affected by some uncertain factors.

Conclusion

The standardized YCECRS provided developmental norm with satisfactory reliability and validity. It helped teachers to understand the development status of children's emotional competence of children. Findings indicated that age and gender were predictive factors. Older children's emotional competency was significantly greater than that of younger children. Children aged 5.5−6 years were significantly more proficient at four aspects of emotional competence than children in younger age groups. Girls were significantly more adept than boys across the four subscales. Children in Central Taiwan were more proficient at understanding others' emotions and inspiring oneself than children in Northern Taiwan.

From the perspective of teaching practice, teachers can apply the YCECRS in assessing the emotional competence of 4−6-year-old children to understand the development status and provide individualized teaching and counselling. Schools can also use the YCECRS as a basis for offering diverse courses, thereby implementing the emotional education effectively. A follow-up study can develop an alternative instrument with which children's emotions can be measured by examining how they manipulate e-blocks (i.e., SIFTEO cubes).

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EXAMINING THE EFFECTIVENESS OF ANTI-BULLYING POLICY IN MITIGATING MOBILE BULLYING IN SCHOOLS IN SOUTH AFRICA

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Abstract
Mobile bullying has escalated in schools and affects students physically and emotionally, subsequently affecting their ability to learn. Schools are under increasing pressure from parents and government to implement anti-bullying policies in order to protect students and create a safe learning environment. However, there are also many conflicting reports about the usefulness of these policies which indicates that there is a need for an examination of their effectiveness in mitigating mobile bullying in schools. The present study investigated the effectiveness of anti-bullying policies in schools in South Africa. A survey of 2007 students was conducted. In the analysis of the results, we did not find support for the claim that possession of anti-bullying policy influence the likelihood to retaliate. However, we found that possession of an anti-bullying policy influences the likelihood of victims to report bullying incidents. Students prefer to report incidents to parents than teachers or schools that developed the policies. This suggests that the policies are ineffective.

Keywords: *Mobile bullying, Effectiveness of anti-bullying Policy, Reporting, Retaliation, High* Schools, South Africa

Introduction

The Department of Basic Education in South Africa requires that schools deal with all forms of bullying issues that arise and establish ways in which to intervene and prevent scholars from being bullied (Western Cape Government, 2014). However, to ensure that school policies are effective in reducing bullying activities in schools, there is a need for a methodical and regular evaluation of the school policies (Bridie, 2013). Not many studies however examine the effectiveness of school anti-bullying policies and those that do have found several weaknesses (Ryan & Smith, 2009; Vorster, 2012). There are also concerns regarding the procedure followed by schools in the development of district policies and the extent to which the policies developed adequately assist in the reduction of bullying practices (Mienie, 2013). The present study, therefore, aims to *examine the effectiveness of anti-cyber bullying policy in mitigating mobile bullying activities in high schools in South Africa.*

Literature review

What is cyber bullying? Many definitions exist of cyber bullying; however, it commonly refers to that form of aggression committed using electronic means such as the Internet, mobile technology and computers. Cyber bullying has serious implications that the department of education in South African requires schools to develop anti-bullying policies as a preventive measure (Creecy, 2012).

Anti-cyber bullying policy content - Studies by Roberge (2011) and Smith, Osborn and Samara (2008) show that for anti-bullying policies to be regarded as being compliant, the school board should adhere to legislature enacted by provincial governments. Ontario legislation requires school anti-bullying policies to include 1) an agreed definition of cyber bullying, 2) stipulating clear rules regarding the use of

technology, 3) measures which will be followed in preventing and intervening if bullying occurs or is reported and 4) clear statement that bullying in any form is prohibited.

Anti-cyber bullying policy development - Smit (2015), further suggests that the development of a school anti-cyber bullying policy should explore consulting with experts in policy development and cyber bullying. A consultative approach to policy development allows for these policies to be broad enough to cover all cyber bullying possibilities (Caruso, 2009). Section 30 (1) of the South African School Act (SASA) allows for contracting of the development of this policy to experts through the establishment of an anti-cyber bullying committee. The Guidelines (paragraph 1.5) require that in the development of an anti-cyber bullying policy consensus must be reached before the policy can be adopted.

Legislation informing policy and compliance - Anti-cyber bullying policies should be legally defensible and enforceable. As such it is important for policymakers to be aware of cyber bullying law requirements and for these laws to be incorporated in the anti-cyber bullying policy (Stuart-Cassel et al., 2011). South Africa has no specific cyber bullying law, however, reliance is placed on fragments of various laws in response to cyber bullying indecencies reported (Badenhorst, 2011). Conforming to legal requirements set forth is necessary to eradicate cyber bullying in schools.

Need for review of the policy and its communication - Roberge (2011) stresses that it is imperative to monitor and revise anti-bullying policies to ensure that they are relevant and effective in addressing bullying. Smith (2015: 6) also concur regular review of anti-bullying policies can be effective in addressing challenges in South Africa. It is also highlighted that legislation makes it mandatory that anti-bullying policies be reviewed and that the policies are to be communicated to the school community, including staff, pupils and parents (Batterbee, 2014). Policies adopted in schools should explicitly define bullying, detailing acceptable and unacceptable behaviour. Also, actions that will be taken in case of non-adherence to policy should also be stipulated.

The following sections detail factors that influence the effectiveness of anti-cyber bullying policies. There exist many factors but this study examines those that have been the main focus of the education department. The Department of Basic Education in South Africa formulated a Schools Safety Strategy that guides schools to develop comprehensive plans to deal with all forms of safety issues facing the school and learners. Schools are expected to periodically review the policy to ensure its appropriateness, effectiveness, and completeness. This policy requires that all incidents that take place at the school must be reported to the principal (if not the perpetrator), and prescribes follow up steps taken (Department of Education, 2011). The other important factor is the extent of victim retaliation. Some of the serious attacks in South African schools are due to retaliation and anger (South African Police Services, 2014). The present study investigates the extent to which these two critical factors that influence bullying (i.e. reporting bullying incidents and retaliation) are mitigated by possession of an anti-bullying policy.

Reporting cyber bullying - Ttofi and Farrington (2011) identified reporting of cyber bullying incidents as one of the key aspects to having an anti-cyber bullying policy. Many studies have been conducted to encourage students to take a stand to cyber bullying by reporting such incidents. It has been found that many students fail to tell anyone because they feel they can handle the situations. Contrary, other researchers attribute the failure of students to report to schools to the ineffectiveness of the anti-cyber bullying policies (Holfeld & Grabe, 2012).

Victims reporting - Students are rather passive to cyber bullying with over 40% of cyber bullied students doing nothing about it (Li, 2010). Students often do not disclose to adults when cyber bullied because "adults do not get it" and those who have reported cyber bullying tend to have their cell phones confiscated and teachers tell them to ignore it (Mishna, Saini & Solomon, 2009). Students also perceive reporting as a waste of time because nothing happens to the bully (Mishna et al., 2009).

Witnesses reporting - Research shows that witnesses to cyber bullying also tend not to report these incidents for varied reasons (Wegge, Vandebosch, Eggermont, Van Rossem & Walrave, 2015). Wegge et al. (2015) and Li (2010) demonstrate a large number of witnesses do not report in fear of being ridiculed and cyber bullied them. The approach a school takes in dealing with reporting bullying incidents is important. This approach should be consistent and clear to all and at all times (Bernard & Mine, 2008).

Retaliation - About fifty percent of cyber bullying victims are said to cope with cyber bullying by confronting the bully. It was also found that students who stood up for themselves were effective in stopping bullying (Parris, Varjas, Meyers & Cutts, 2011). It could also mean that students consider the anti-cyber bullying policy to be ineffective hence take matters into their own hands.

Policy mitigates Mobile phone victimisation - Von Mare´es and Petermann (2012) emphasise the importance of an anti-cyber bullying policy in encouraging right behaviour for students. Continued bullying, while there is a policy in place suggests ineffectiveness of the policy and need for better policy development and communication. Schools that consistently apply anti-bullying policy have been found to have lower rates of bullying (Campbell, 2005).

Conceptual model

While the above section indicates that there are many factors influencing anti-cyber bullying policy effectiveness, the present study will focus on only the likelihood of victim retaliation and the level of reporting of bullying. This is because reporting and likelihood of non-retaliation have been identify to be key in stopping bullying and thus students need to be encouraged to speak up (Craig, Pepler & Blais, 2007; Creecy, 2012). However, the impact of these factors on the effectiveness of an anti-bullying policy has not been examined. In addition, an effective anti-cyber bullying policy is expected to mitigate the mobile phone victimisation (Von Mare´es & Petermann, 2012; Ttofi & Farrington, 2011). The conceptual model for this study is presented in Figure 1 below. The effectiveness of an anti-cyber bullying policy was determined by the extent to which respondents in schools with policies did not retaliate and report the incidents especially to their teachers. The following scale was used: (1 = not effective, 2 = moderately effective, 3 effective, 4 = very effective).
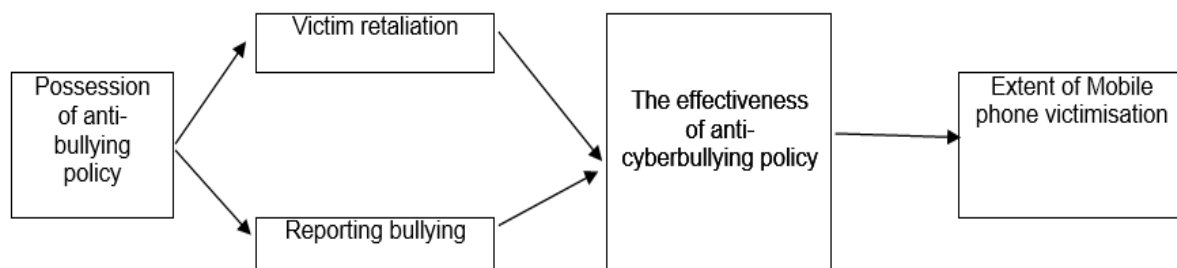
Figure 1. Conceptual Framework

Propositions

Researchers argue that an anti-cyber bullying policy has reasonable success rate in preventing cyber bullying (Ttofi & Farrington, 2011). Students who react in a distressed manner to being bullied put themselves in a vulnerable and risky position, as it may result in the bully continuing victimising in response to the retaliation of the victim (Bernard et al., 2008). Some students feel a more confrontational

approach and sometimes bullying back is the best coping strategies when bullied (Slonje et al., 2013). Therefore, it is proposed that:

Proposition 1a: Possession of an anti-bullying policy influences the likelihood to retaliate.
Proposition 1b: Possession of an anti-bullying policy influences bullying reporting.

Research shows that most victims to cyber bullying tend not to report the incidents to adults. Bernard et al. (2008) states that victims have difficulties in reporting bullying because they have no confidence in the way schools handle the cases. We argue however that since an effective anti-cyber bullying policy aims to instil confidence in the school's ability to address bullying, witnesses to bullying in schools with policies will be encouraged to report the incidents to the teachers. We therefore proposed that:

Proposition 2: The choice of the person reported to by a witness will differ by possession of an anti-cyber bullying policy.

Since an anti-cyber bullying policy consistently applied in schools is expected to lead to effective management of mobile phone victimisation (Slonje, Smith & Frisén, 2013; Von Mare´es & Petermann, 2012; Ttofi & Farrington, 2011), we predict that:

Proposition 3: The effectiveness of an anti-bullying policy will negatively influence mobile phone victimisation.

Research Methodology

Students in the Limpopo province were invited to participate in the study. Firstly, permission was sought from both the Limpopo Department of Education and the Lebowakgomo district in order to conduct research in schools within those areas. Secondly, consent from the principals of the participating schools, parents of the students and the students themselves were sought. The students' participation was voluntary and was indicated in the consent forms. A questionnaire developed using the key issues identified in literature was then administered to the students in the form of hard copies. The questionnaire consisted of structured questions with a Likert scale of 1-5 (e.g. 1-lowest and 5-Highest) and open questions that required participants to write down their experiences instead of choosing from the options given in the Likert-scale. The questionnaire also captured some descriptive data.

Research Finding

Participants - A total of 2007 high school students (grades 8 to 12) from the Limpopo Province were surveyed. Of the responses 53.26% were female and 46.74% males. Students' ages ranged from 14 to 18 with the majority of the students being 18 (78%). The average age of the students was 16 years.

Reliability - Cronbach's alpha was used to test for reliability (Creswell, 2009). It measures the reliability of the scale by determining how well the items represent a single dimension. Most of the variables exceeded the threshold of 0.7. However, mobile phone victimization had a Cronbach's alpha of 0.578 (approximately 0.6). A threshold of 0.6 is also acceptable in exploratory studies (Hair, Black, Babin, Anderson & Tatham, 2006).

Results

Descriptive Statistics - In examining the data collected from responses in 8 different schools, key focus was placed only on those that reported that their schools had anti-cyber bullying policies in place. The data indicates that out of the 2007 student surveyed only 517 reported that their schools had an anti-cyber

bullying policy. The distribution by school is presented in Table 1 below. Almost 40.55% of students in school A reported having an anti-cyber bullying policy, followed by school B (31.13%) and school D (26.65%).

Descriptive Data of Students in Schools with Anti-bullying Policies			
School	Number	Respondents who agreed to having Policy	% Respondents who agreed to having Policy
A	217	88	40.55
B	212	66	31.13
C	191	31	16.23
D	424	113	26.65
E	228	48	21.05
F	265	56	21.13
G	214	50	23.36
H	256	65	25.39
Total	2007	517	25.76

Table 2 Descriptive data - Schools with anti-bullying policies

Mobile phone victimisation - The Means and standard deviations of victimised students in general and victimised students in schools with anti-cyber bullying policies were calculated and compared using a t-test. The Means and standard deviations of the victimised students (i.e. receive insulting messages and calls) are presented in Table 2. Students reported to having "Received Threatening Calls" (mean of 3.71) and "Received Threatening Messages" (mean of 3.94) which suggest that they are more commonly exposed to these forms of mobile phone victimisation. "Retaliation" with a mean of 2.69 suggests that respondents are between "would not consider" and "unsure" of whether they would get back at those who bullied them.

			All				Female					Male			
	N	M*	Min	Max	Std	N	M	Min	Max	Std	N	M	Min	Max	Std
Received Insulting Message	445	3.62	3	5	0.84	215	3.5	3	5	0.82	230	3.67	3	5	0.86
Received Threatening Call	443	3.71	3	5	0.82	214	3.4	3	5	0.72	229	3.86	3	5	0.83
Received Threating Message	393	3.94	3	5	0.87	192	3.8	3	5	0.93	201	4.03	3	5	0.84
Retaliation	406	2.69	1	5	1.55	193	2.4	1	5	1.67	202	2.81	1	5	1.51
Witness to bullying	440	3.23	1	5	1.21	194	2.8	1	5	1.11	202	3.42	1	5	1.23

Scale: (1 =Never, 2=Rarely, 3=Sometimes, 4=Often, 5= Always)

Table 3 Descriptive data - Mobile phone victimisation in schools (M* = Mean)

Policy and mobile victimisation – There were 116 victimised students in schools with anti-cyber bullying policies in place. These students received insulting messages (mean = 3.62); received threatening calls (mean = 3.71) and also received threatening messages (mean = 3.94). A t-test was then run to show whether the differences in the means of these results were significant. The results were significant (t= 4.1440, p=0.0045).

Policy and Choice of the person reported to
We also determined if the choice of the person reported to by the victim differ by possession of an anti-cyber bullying policy. Chi-square results indicate that the differences in percentages are significant (Table 3 below). In both schools with and without policies, victims prefer to report to parents than teachers or friends.

Summary Table: Expected Frequencies Marked cells have counts > 10 Pearson Chi-square: 17.8507, df=4, p=.001320 (Victimised students)						
Policy	Report To None	Report To a Friend	Report To Parent	Report To a teacher	Report To Police or Legal person	Row Totals
School has a policy	23	25	51	15	2	116
School does not have a policy	66	70	144	44	5	329
All Grps	89	95	195	59	7	445

Table 3 Results of Chi-Squared Test

Possession of Policy and likelihood to retaliate –
We also determined if possession of an anti-bullying policy influences the likelihood of the victim to retaliate. Retaliation was measured with a scale of (1) definitely would not consider, (2) would not consider, (3) Unsure, (4) Would consider and (5) definitely would consider. The results show that victimised students in schools with or without anti-bullying policies would not consider retaliation. However, the response of those in schools with anti-bullying policies was firmer than those without a policy (mean results were 1.51 and 1.85 respectively). We conclude, therefore, that possession of a policy does not influence the likelihood to retaliate. T-test results also confirmed the significance of the differences (t = 2.71, p =0.007).

Regression Analysis – The influence of effectiveness of anti-cyberbullying policy on Mobile victimisation
We also conducted a regression analysis to determine the influence of effectiveness of anti-cyber bullying policy on mobile phone victimisation. First the data was standardised as it was measured on different scales. The regression coefficient of these results was negative and significant at -0.35 (p<0.05). This confirms that an effective anti-cyber bullying policy negatively influences mobile bullying victimisation. Proposition (3) is therefore supported.

Discussion and Conclusion –
This study sought to explore the effectiveness of school anti-cyber bullying policies in reducing bullying activities by looking at mobile phone victimisation, victim retaliation and reporting patterns of bully victims and witnesses. The findings provide important insight into the state of the bullying policies in schools. Victims may engage in bullying in retaliation). However, victims may retaliate as a means to prevent being victimised again. The present study did not find sufficient evidence to support the claim that possession of policy influences retaliation. Therefore, proposition (1a) is not supported. We also found that possession of a policy would influence bullying reporting. We found that victimised students are more comfortable reporting to parents than teachers, friends or the Police. Interactions (regarding being cyber bullied) with some students suggest fear of being labelled, while reluctance to report to teachers (i.e. the schools) is an indication of the ineffectiveness of the policy. Propositions (1b) and (2) were, therefore, supported. More effort is, therefore, needed to encourage students to report to their schools or teachers (Craig et al., 2007). Finally, the regression analysis results confirm that an effective anti-cyber bullying policy negatively influences mobile phone victimisation. Therefore, proposition (3) is supported. This suggests that if schools could encourage no-retaliation and reporting of incidents to schools, there would be a reduction in the level of mobile phone victimisation.

There are however limitations to this study. Due to time constraints, this study did not look into all factors that determine the effectiveness of an anti-bullying policy. Further studies may, therefore, analyse the school policies further and investigate other possible influencing factors. There is also a need to examine the content of anti-bullying policies to determine whether its development takes form of a collaborative process.

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WHAT INFLUENCES STUDENTS' PARTICIPATION IN ONLINE COLLABORATIVE LEARNING? A CASE STUDY

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Abstract:

Online learning is growing quickly across all education settings. Students are increasingly demanding online access, and educational institutions are running to meet the demands. Many virtual high schools have been established and hundreds of online courses in all subjects are now available for students. Theoretical as well as empirical analyses highlight the importance of active participation and collaboration among students in fostering the effectiveness of online learning. Yet, online collaborative learning activity is still undervalued and demoted. The purpose of this study is to explore and investigate some of the factors that influence students' effective participation in online collaborative learning and discussion. A qualitative research design of a case study was implemented, and an observation as well as an interview was utilized to collect the data for this study. The researcher monitored a student during her work on a grade eleven online math course. The student received a very good final grade for this course; however, a very low participation in the collaboration and thread discussion was observed. Some factors were found to be related to this poor participation. Relevant literature, findings, and recommendations are discussed in this article.

Keywords: online learning, online collaboration, online discussion

Introduction:

According to "The 2014 State of the Nation: K-12 Online Learning in Canada" report by Barbour and LaBonte (2014), during the 2013-14 school year, there were about 332,000 (6.2%) K-12 students across the country enrolled in one or more distance or online education course, with an increase of about 50,500 students from the previous school year. In the province of Ontario alone, during the same school year of 2013-14, there were 78,095 K-12 distance education students (Barbour & LaBonte, 2014). With this increase of K-12 e-learning students, the need for more effective and high quality online education becomes even more crucial. Student-teacher interaction, student-student collaboration, and active learning have been effectively related to the quality of an online learning in a similar way as they are important in face-to-face educational environments (Chen, Gonyea, & Kuh, 2008). High quality online learning course involves opportunities for students to engage in collaborative activities with their peers, which has been contribute to the development of important skills, such as critical thinking, self-refection, and knowledge co-construction (Brindley, Walti & Blaschke, 2009).

Collaborative learning has been variously described as cooperative learning, team learning, peer learning, collective learning, or learning communities. According to Dooly (2008), collaborative and cooperative learning are both based on constructivism; however, collaborative learning is more comprehensive than cooperative learning. While the collaboration includes the whole process of learning where students help each other to understand and learn, cooperative learning "is a process meant to facilitate the accomplishment of a specific end product or goal through people working together in groups" (Dooly, 2008, p.21). Siemens (2002) discussed a four-stage continuum for learner-learner interactions in an e-learning course that can be viewed as: a) Communication – "people 'talking', discussing;" b) Collaboration – "people sharing ideas and working together (occasionally sharing resources) in a loose environment;" c) Cooperation – "people doing things together - but each may still have their own purpose;" d) Community – "people striving for a common purpose" (p.1).

Research has revealed that collaborative learning not only increases interest among learners but also fosters critical thinking and improves problem-solving strategies (Bruner, 1985; Gokhale, 1995; Johnson & Johnson 1986). Gokhale (1995) concluded that collaborative learning promotes critical thinking through discussion, clarification of ideas, and evaluation of the others' ideas. Bruner (1985) articulated that cooperative learning enhances problem-solving methods as learners discuss and deal with different interpretation of a certain situation. Cross (1998) discussed that students who are involved in group activities are significantly more likely to show growth in intellectual interests and values than their less involved peers. Although cooperative learning strategy helps teachers to construct a student-center learning environment, Wang (2007) identified several challenges in designing such an environment, such as "free-rider effect, the unified course schedule, and the difficulties of designing meaningful activities, managing noisy and chaotic classroom, grouping the students, facing attendance rate or distracted students and evaluate a vast of students' test grades" (p.28).

Online learning ecologies have been called to be potential promising collaborative learning facilitators. According to Siemens (2005), online learning communities not only facilitate sharing of information and knowledge "co-construction" (Brindley et all, 2009) but also support life-long learning at both the individual and the group level through interaction and dialogue. Studies have indicated that online collaborative learning could provide more equality in group work than the actual face-to-face group work (Cohen, 1994; Johnson, Johnson & Holubec, 1993; Kessler, 1992). Hoag and Baldwin (2000) articulated that not only students performed better and learned more in an online collaborative class, but also acquired a greater experience in teamwork, time management, communication, and the use of technology, when compared to a face-to-face classroom.

Creating an online collaborative or cooperative work is a challenging issue, but not impossible. Building on the research of Paulus (2005), Morrison (2012) stated that forming virtual groups and teams as well as providing them with assignment guidelines does not create meaningful online collaborative leaning that would really engage higher thinking skills, yet, effective online collaborative learning depends on how the team task is structured, communicated, and supported. Morrison (2013) also discussed several reasons that may prevent students from participating in online discussions, such as unclear of expectations, shyness, technical difficulties, discontent, poor discussion etiquette, inappropriate timing, discouragement by shallow and unrelated posts, and finally, lack of motivation.

Brindley and colleagues (2009) examined the role that the assessment (assignment of a grade) plays in engaging students in online collaborative learning groups. Swan, Shen & Hiltz (2006) see the assessment as the "engine" that create, encourage, and shape collaborative learning online. However, Brindley et al. (2009) found that "introduction of grading has made no discernible difference to participation in study groups" (p.2). They found that although the assessment enhanced participation for some students, the other factors, specifically, instructional strategies, achieved the same objective, and in fact could be more effective in this regard. The strategies that proved to be effective in motivating students to participate in the study group include: transparency of expectations, clear instructions, appropriateness of task for group work, meaning-making/relevance, motivation for participation embedded in course design, readiness of learners for group work, timing of group formation, respect for the autonomy of learners, monitoring and feedback, and sufficient time for the task (Brindley et al., 2009, p.7).

The purpose of this study is to explore and investigate the factors that influence student's effective participation in online collaborative discussion and learning since only a few research studies thus far investigated students' engagement and participation in online collaborative learning activities at K-12 level. Specifically, this case study will try to answer the following three questions:

1. How does the student see the importance of participating in online collaboration learning activities?
2. What are the factors influence the students' participation in online collaborative learning activates?

Method and Materials:

Based on the theoretical discussion above, the researcher aimed to closely investigate how students interact with and participate in online collaborative learning activities and discussion threads. Therefore, an arrangement was made to observe and interview a student while taking a high school online math course.

The course:
The student was registered in a grade 11 math course called MBF3C Foundations for College Mathematics offered at one of the Ontario's Virtual High Schools during summer 2015. Although this course didn't mandate from students to participate in collaborative learning projects, it encouraged them to participate in the open discussion threads where they could post their questions about the course materials, describe their experiences with the course assignments, and receive feedback from their teachers and peers. The course managing system displayed the number of all received and unopened posts at the top left corner at the front page of the student's course account. In addition, to complete each unit of the course, the students were required to post their comments about their learning experience in each particular unit. These posts were seen by all students registered in the course in the same session. Also, students had an opportunity to reflect on and discuss their comments through the discussion board. There was no direct or indirect guidance for posting; students could post as many posts as they wanted and discuss any topic regarding their learning.

The study participant:
The participant was a female student, who has already completed her high school diploma in the USA. She intended to gain the admission into a business diploma at one of the community colleges in Ontario. Completing the math course was a requirement for this admission. Although the student completed her high school diploma in the USA, it must be mentioned that English was her second language. The student has taken some e-learning courses during her high school studies, but this was her first full online course taken in Canada.

Data Collection and Analysis

To develop an improved understanding of what influences students' participation in an online collaborative learning, the researcher used the case study method to collect the data. According to Yin (1994), case study is preferred method to answer "how" and "why" questions. Zainal (2007) discussed that case study research could be exploratory, explanatory, descriptive, and interpretive. This study aims to describe and explain some of factors that might influence students' participation in online discussion.

For the purpose of this study, three sources of data were analyzed:
1. *Weekly self-report*: the student was asked to complete a self-report form, designed by the researcher, which included the information on the number of lessons completed, time spent studying, number of discussion posts received, read, initiated, and replied to. There was a total of six completed self-reports at the end of the course. Information from the reports were gathered, sorted, and analyzed.
2. *Observation*: the researcher obtained the approval from the student to observe for one hour a week her engagement in the course. There were total of eight observation sessions. Although the researcher observed all activates, the main focus was on the process how the student interacted with the discussion part of the course. The notes from the observations were gathered, sorted, and classified.
3. *Semi-structured interview*: the researcher interviewed the student in a two-hour-long one meeting at the end of the course. The focus of the interview questions was on the factors that influenced or hampered her participation in the course online discussion board.

Findings and Discussion:

The following findings emerged from the analyses of the data collected.

1. The student completed the course with a very good academic performance. She was able to successfully complete the course in two months with a final grade of 84. The student completed all the assignments, tests and quizzes on time. Participating in the online discussion wasn't required and wasn't part of the course evaluation.
2. At the end of the course, there were 275 unread posts in the student's discussion board. The student started the course by reading and replying to all posts from the other classmates. However, gradually, she participated less in the discussion. Based on the data from the self reports, the student completely stopped writing new or replying to received posts after the second week of the course and stopped reading the posts at week 5, almost half-way to the end of the course. The student never participated in the online discussion during all observation sessions. The researcher wasn't able to read the content of the student's posts.
3. To answer the questions of what influenced her participation in the online discussion, the student mentioned that she has lost the motivation to participate in the online discussion due to the following reasons: a) the online discussion wasn't required to pass the course; b) there were so many posts that reading or replying to them would waste most of her time; c) the teacher wasn't active with the students on the discussion board; d) the discussion was open with no clear instructions or guidance; e) she didn't receive any feedback or replies from the other students or the teacher to many of her posts; f) students used "slang language" in their comments which was at times difficult to understand; g) many comments and posts were, according to her, "shallow and out of context;" h) it was difficult to navigate between new and old posts; and finally, i) she was not able to use a smart phone to participate in the online discussion board.
4. The student believed that collaborative learning and discussion would be useful, only if it was designed properly. She also indicated that if the discussion was required, she "would do it", but this would not motivate her learning.

The literature review clearly outlined the benefits of online collaborative learning. In Slavin's (1989) words, "Researchers agree that cooperative learning can produce positive effects on achievement but disagree on the conditions under which the approach is effective" (p.52). For instance, according to him, online collaborative learning can't be effective without "group gales" and "individual accountability". This study identified several important factors that can impede or encourage students to participate actively in collaborative learning. The fact that the participation in online discussions was not mandatory contributed to the student's disengagement in these discussions. However, making the participation mandatory would not guarantee effectiveness of collaborative learning. This observational case study is in concert with the findings of other studies that identified other factors that influence students' participation in online collaborative learning and discussions, such as the time, content of the posts, and the poor feedback from the teacher and the peers Morrison (2013). Future research will need to examine more carefully these factors and identify mechanisms by which teachers can increase students' active engagements in collaborative online learning.

Conclusions:

This study investigated the factors that may influence students' participations in online collaborative learning and discussions in a K-12 online course. The factors found in this study were similar to those discussed in the literature. Although the findings emerging from individual case studies cannot be generalized; the findings of this study seem to support Swan's (2001) argument that online collaborative learning and discussion have been found remarkably unsuccessful. The findings indicate that online learning still need to include more emphasis on the instructor interaction and students' engagement. In general, online education and pedagogy require more investigation and development.

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