

Research Paper

How to Engage Students with Diverse Computing Backgrounds in the Learning Process?

by

Athraa Al Mosawi, University of Bahrain, College of Information Technology, Department of Information Systems, aalmosawi@uob.edu.bh

Sofiane Sahraoui, Institute of Public Administration, Bahrain, s.sahraoui@bipa.gov.bh

ABSTRACT

An experimental study was conducted using two sections of an undergraduate computer course at the University of Bahrain to investigate the problem of engaging students with different computing backgrounds in the learning process. Three approaches were used to engage students: teacher-centered, student-centered and blended. The latter two approaches proved to be effective with engaging students. They also showed an improvement in students' performance and teamwork skills. The blended approach proved superior in increasing student confidence level in their learning.

KEYWORDS:

Student Learning, Student-Centered, Teacher-Centered, Blended Learning

INTRODUCTION

Today's classrooms are filled with diverse learners who differ in their cognitive abilities, background knowledge and learning preferences. Such diversity has posed challenges to teachers to effectively address all students' learning needs.

Faced with such diversity, many researchers suggested the move from a teacher-centered to a student-centered approach. Altan and Tromby (2001) offer student-centered learning as a model for countering classroom challenges because of its viability for meeting diverse needs. McCombs (1997) argues that the student-centered approach assists in clarifying what is needed

to create positive learning contexts to increase the likelihood that more students will experience success.

Tomlinson (1999), Brown (2003), Fadul (2004) and many others, argue that teacher-centered approach is inadequate to meet diverse students' needs. In the teacher-centered approach, teachers put more emphasis on the transmission of knowledge rather than on developing students' learning skills. The effort to get to know the students and how they process information is secondary. While in the student-centered approach, the knowledge is constructed by students and the lecturer is only a facilitator of learning. The role of the teacher would be to know students capabilities and create an environment where students can make learning connections. In this way, students become more active participants in the learning process and take greater responsibility for their own learning. Tomlinson (2000) argues that teacher narratives and the emphasis on learner characteristics make the student-centered approach a viable alternative for matching teaching practices with learner needs.

Despite the trend of moving from a teacher-centered approach to student-centered approach, there are still many researchers who believe that the teacher-centered approach is effective. Biggs (1999) argues that this approach is appropriate especially when the teacher is the one who comes from a position of expertise. Xiaohui (2006) emphasized that rather than abandoning teacher-centered approaches, the instructor needs to make modifications to traditional teaching methods according to new ideas and methods. A blended approach combining elements of both a teacher-centered and student-centered approach has been proposed to this effect.

Graham (2005) argues that it is better to move to a blended approach where the instructor enriches the lecture and classroom environment using a combination of face-to-face instruction with some new approaches. The issue of which approach is best will be explored in this research in the context of teaching computing to students with different level of preparedness in a developing country context.

RESEARCH BACKGROUND AND PROBLEM

As part of its ICT foundation courses, The University of Bahrain offers many courses in computing. These courses aim to build student proficiency in computer applications.

Courses last one-semester and carry four credit points. The Computer and Business Information System course, which will be setting for this research, has three-hour lectures in the classroom and one-hour practice in the computer laboratory per week. Classroom lectures are delivered through slide presentations by means of modern multimedia devices. In the laboratory, students are guided to learn popular productivity tools such as spreadsheets and database management.

One of the co-authors has been teaching this course for several years using a teacher-centered approach. This approach was perceived to be necessary because more than 15 sections per semester were offered with at least 25 students per section. Indeed, the numbers of sections and the need to standardize teaching delivery across the sections made it necessary to adopt a teacher-centered approach.

Students who register in this course come from different school backgrounds where computing is taught in many different ways. Graduates of government schools are taught computing in Arabic whereas graduates from private school are taught in English very early on. The computer curriculum is also very much different between the two systems. Private schools have generally more computing resources than public schools and afford students better practical training. Such diversity of student computing backgrounds poses challenges to instructors to make class time worthwhile for all learners.

In many instances, the diversity of students' computing backgrounds is manageable. However, when the distribution of the class is such that there are two distinct groups of students with radically disparate levels of computing knowledge, the instructor faces an insurmountable task to manage this difficult situation and to provide value added learning across the classroom.

Focusing on just one level of students' background can alienate parts of the class. Hence, if a course is tailored to meet the needs of students with a more advanced computing background, much of the class will be left behind and will likely fail the course. Conversely, if a class is tailored to meet the needs of student with no or little computing knowledge, then more knowledgeable students will lose interest. The question is then how to engage students of different computing backgrounds in a joint learning process? This will be the major objective of this research.

Answering this question will enable the satisfaction of requirements of both low performing as well as high achieving students in computer courses and subsequently introducing changes to the current teaching practice that is predominantly teacher-centered.

RESEARCH METHODOLOGY AND PLANNING

In preparation for designing a solution that will engage students with diverse computing backgrounds in the learning process, this research will investigate a teacher-centered vs. student-centered approach and student-centered vs. blended approach.

The sample of the study included two sections of *Computer and Business Information Systems* with 24 students enrolled in each section. At the beginning of the study, students were briefed about the objective of the research. They were verbally informed of the purpose of the research and were given a Consent and Authorization form to sign. Furthermore, the students were assured of the confidentiality of the information they would provide. Students were also reassured that this research would not enter in any way into the final assessment for the course.

The students were then asked to sit for a pre-test to ascertain the differences in computer backgrounds that existed between all participants. The pre-test would reflect the students' backgrounds prior to any instruction and the required improvement, if any, in their computing knowledge and skills after using the different approaches.

The pre-test consisted of 10 questions related to communications and network topics. The students were required to provide general answers to the questions based on their background. This test aimed to measure their communications and network knowledge. Based on their scores in the pre-test, students were placed into three groups: low (total mark < 5), moderate (total mark =5) and high (total mark >5). Table 1 illustrates the results of the pre-test for both sections.

Table 1: Pre-test scores for computing backgrounds

	Number of Low-Score Students	Number of Moderate-Score Students	Number of High-Score Students
Section One	10	6	8
Section Two	12	4	8

As expected, the results of the pre-test showed that there exists three different levels of student backgrounds. Low-score and high-score students were the primary focus of this research.

As stated earlier, three approaches (teacher-centered, student-centered and blended) were used with the intention to engage students with diverse computing background in the learning process. In a first cycle, a teacher-centered approach was used within one section and a student-centered approach within the other section. Then students were given a quiz to compare the two approaches based on student scores. In cycle two, a swap was done of the teaching methods between the two sections in order to investigate if the level of students had affected the results of cycle one. In a third cycle, a blended teaching approach was introduced within one section and a student-centered approach in the other section. Doing so allowed a direct comparison between the three teaching approaches using the same sections. However the learning and assessment objects were obviously changed through remained within the same topic.

In designing the lesson plan, presentation slides were used for the teacher-centered approach. For the student-centered approach, a case study was developed to push students to discover and learn the topic independently. This aligns with Trigwell's *et al.* (1999) suggestion that in the student-centered approach, teachers adopt a student-focused strategy to help the learners change their world view or concept of the phenomena they are studying.

For student-centered approach, students were assigned to six groups of four members each. A peer learning method, in which learners help each other through group work, was used. This aligns with King's (1997) suggestion that in a student-centered approach, a teaching program needs to include materials and strategies that are interesting, motivating and requires the learners to be involved not only in individual tasks but also in cooperative tasks. High-scoring students were coupled within groups with students who had low scores in the pre-test.

Directly after going through each approach, students were asked to sit for a post-test and to complete a questionnaire. The post-test aimed to measure students' performance after going through the teaching approach whereas the questionnaire aimed to elicit students learning skills, developed skills, feelings and attitudes toward the teaching approach. The questionnaire was specifically developed for purposes of this research.

RESULTS AND DISCUSSION

Teacher-Centered Vs. Student-Centered Approach

Both tests for teacher-centered and student-centered were marked by awarding one mark for the correct answer and zero for the wrong one. Table 2 and Table 3 illustrate the results of the t Test conducted to compare the results of the two tests. The paired-sample t test analysis indicates that for the 24 subjects, the mean score on student-centered test ($M=7.875$) was significantly greater than the mean score of teacher-centered test ($M=6.208$) at $p < .05$. In other words the difference between the scores of both tests is statistically significant.

Table 2: Post-test mean score analysis for teacher-centered vs. student-centered

	Mean	SD	No.
Teacher-Centered Approach: Post-Test	6.208	1.350657	24
Student-Centered Approach: Post-Test	7.875	1.034723	24

Table 3: t-test analysis for teacher-centered vs. student-centered

	t-calculated	df	t-critical
Teacher-Centered and Student-Centered Approach: Post-Test	-4.79883	46	1.9475

The results show that the student-centered approach is more effective than the teacher-centered approach in improving the students' overall performance. The questionnaire also showed that students, with the student-centered approach, developed better teamwork skills in addition to learning skills. There was a change in the class environment as well as students with different computing backgrounds were engaged in learning process.

To control for rival explanations resulting from differences in the level of students and the topic, a swap of the teaching approach was done between the two sections.

Table 4 and Table 5 illustrate the results of the t Test conducted to compare the results of the two tests. The paired-sample t test analysis indicates that for the 24 subjects, the mean score on student-centered test ($M=8$) was significantly greater than the mean score of teacher-centered test ($M=6$) at $p < .05$. In other words the difference between the scores of both tests is statistically significant.

Table 4: Post-test mean score analysis for student-centered vs. teacher-centered approaches

	Mean	SD	No.
Teacher-Centered Approach: Post-Test	6	1.44463	24
Student-Centered Approach: Post-Test	8	1.021508	24

Table 5: t-test analysis for student-centered vs. teacher-centered approaches

	t-calculated	df	t-critical
Teacher-Centered and Student-Centered Approach: Post-Test	5.537749	46	1.9475

Other than students performing better in the post test when subjected to a student-centered approach rather than a teacher-centered approach, improvement in student academic performance, when comparing the post-test to the pre-test, was significantly higher with the student-centered approach than with the teacher-centered approach (Table 6 and Table 7).

The low-score student group across the two sections, as identified in table 1, further improved its score with the student-centered approach than with the teacher-centered approach. Likewise, high-score students increased their overall performance with the student-centered approach. Communication skills increased for all along with their academic performance. By working in groups, students learned to take more responsibility for their own learning. This is in line with Tomlinson (1999), Brown (2003) and Fadul (2004) findings who argued that students become more active participants in the learning process with a student-centered approach and take greater responsibility for their own learning.

Table 6: Pre-test/post-test comparison for low-score and high-score students for section 1

	Section One		
	Pre-Test Average	Teacher-Centered Post-Test Average	Student-Centered Post-Test Average
Low-Score Student Average	2.7	4.6	7.0
High-Score Student Average	6.0	7.0	9.0

Table 7: Pre-test/post-test comparison for low-score and high-score students for section 2

	Section Two		
	Pre-Test Average	Teacher-Centered Post-Test Average	Student-Centered Post-Test Average
Low-Score Student Average	3.1	5.3	7.4
High-Score Student Average	6.25	7.5	9.0

Based on the questionnaire analysis, most students indicated that, with the teacher-centered approach, a significant portion of class time was spent copying information whereas, with the student-centered approach, they felt that critical thinking was encouraged and that the method enabled them to actively get involved in class activities and discussions. In addition to learning skills, most students responded that the student-centered approach allowed them to develop teamwork skills such as communication skills and interpersonal skills.

Although student performance and learning skills increased with the student-centered approach, many students expressed that they were not very confident that their peers provided them with the correct information during group work. Example of such comments include: “Although today’s class is enjoyable, I still believe that the teacher can give us more than our peers.”, “I have learned from my peers but am not sure what I have learned is correct and enough, I think I need my teacher’s help because the subject is too technical.”, “I like to discuss my thoughts with my peers but I don’t trust their thoughts.”, “Although I do not feel shy to ask within the group but still I believe that my teacher provides us with more accurate information.”. This gives an indication that an approach blending pure student-centered methods with teacher-driven methods would be a good compromise.

Student-Centered Vs. Blended Approach

On this premise, a new experimental design was introduced having the instructor intervene to deliver the foundational technical information and then allow the students to construct detailed information. This aligns with Biggs’ (1999) and Graham’s (2005) in that teacher intervention is necessary especially when the teacher is the one who comes from a position of expertise. This new set up allowed for the comparison of student-centered approach, which was already proven to increase student performance, with a blended approach, which includes elements of both a student-centered and teacher-centered approaches.

Table 8 and 9 illustrate the results of the t Test conducted to compare the results of the two tests. The paired-sample t test analysis indicates that for the 24 subjects, the mean score on blended test (M=9.2) was significantly greater than the mean score of student-centered test (M=8.5) at $p < .05$. In other words the difference between the scores of both tests is statistically significant.

Table 8: Post-test mean score analysis for blended vs. student-centered approach

	Mean	SD	No.
Blended Approach :Post-Test	9.2	.931533	24
Student-Centered Approach: Post-Test	8.5	1.021508	24

Table 9: t-test analysis for blended vs. student-centered approach

	t-calculated	df	t-critical
Blended vs. Student-Centered Approach: Post-Test	2.510074	46	1.9475

Moreover, the questionnaire analysis showed that, in comparison to the student-centered approach, and other than the improvement in their learning, the blended approach allowed students to cooperate and develop teamwork skills. In addition, students responded that they gained more confidence through the blended approach. Some of the comments in this regard: “I feel I am good at computers”, “Computing is challenging and I like to learn more.”, “I am not shy anymore and I believe that I can bravely discuss my beliefs and thoughts with my peers.”

The results show that the blended approach not only improved the test scores of all students as well as their communication skills, but it also increased student desire to learn computing, improve in computing, and increase their confidence in their computer abilities. This implies that the student engagement, learning skills and teamwork skills improved using the blended approach.

IMPLICATIONS AND RECOMMENDATIONS

Many studies investigated ways to engage different student levels in the learning process; most of which agreed that student-centered approaches engage diverse learners (McCombs,1997; Tomlinson, 1999; Brown, 2003; Fadul, 2004). The findings of this research align with earlier studies. Students with different computing backgrounds were engaged in the learning process through a student-centered approach. Not only has their engagement improved, but also their overall performance has increased. It also promoted student independent learning, thinking and teamwork skills.

Furthermore, this research found that a blended approach is even further effective not only in engaging diverse learners but also by increasing the level of confidence of students in what they

learn. Compared to a student-centered approach, blended learning shows an improvement in student performance, teamwork skills and confidence in their computer abilities.

The above results should be confirmed through more rigorous experimental designs with different learning contexts, a larger sample, and more strict experimental procedures. Only then, we will be able to ascertain the above findings.

REFERENCES

- Altan, M.Z. and Trombly, C. (2001) Creating a learner-centered teacher education program. *Forum*, 39(3), 28-35.
- Biggs, J. (1999) *Teaching for quality learning at university*. Buckingham: Open University Press.
- Brown, K. (2003) From teacher-centered to learner-centered curriculum: improving learning in diverse classrooms. *Education*, 124(1), 49-54.
- Fadul, J. (2004) The learning-centered paradigm: Synthesis of curriculum-centered and learner-centered paradigms. *International Journal of Learning*, 12(4), 161-173.
- Flowers, D. P., Hancock, D.R. and Joyner, R.E. (2000) Effects of instructional strategies and conceptual levels on students' motivation and achievement in a technology course. *Journal of Research and Development in Education*, 33(3), 187-194.
- Graham, C. R. (2005) Blended learning systems: Definition, current trends, and future directions. In Bonk, C. J.; Graham, C. R. *Handbook of blended learning: Global perspectives, local designs*. San Francisco, CA: Pfeiffer. pp. 3–21.
- Hancock, D. R., Bray, M. and Nason, S. A. (2002) Influencing university students' achievement and motivation in a technology course. *The Journal of Educational Research*, 95(6), 365-372.
- King, M. (1997) How people learn and implications for teaching. In R. Brooks (Ed.) *NSW Agriculture Research Review*.
- Lingard, R. (2010) Teaching and assessing teamwork skills in engineering and computer science, *Journal of Systemics, Cybernetics and Informatics*, 8(1), 34-37.
- McCombs, B.L. (1997) Self-assessment and reflection: Tools for promoting teacher changes toward learner-centered practices. *NASSP Bulletin*, 81(587), 1-14.
- Morell, L., Vélez, J.L., Zayas, J.L. and Torres, M. A. (1998) Developing and Assessing Teamwork Skills In a Multi-Disciplinary Course, *Frontiers in Education Conference*, Tempe, Arizona.
- Tomlinson, C.A. (1999) *The Differentiated Classroom: Responding to the needs of all learners*. Alexandria, VA: Association for Supervision and Curriculum Development.

Tomlinson, C.A. (2000) Reconcilable differences? Standards-based teaching and differentiation. *Educational Leadership*, 58(1), 2-6.

Tomlinson, C.A. (2001) *How to Differentiate Instruction in a Mixed Ability Classroom*, 2nd ed. Alexandria, VA: Association for Supervision and Curriculum Development.

Trigwell, K., Prosser, M. and Waterhouse, F. (1999) Relations between teachers' approaches to teaching and students' approaches to learning. *Higher Education*, 37, 57-70.

Xiaohui, H. (2006) Improving teaching in computer programming by adopting student-centered learning strategies. *China papers*, 6,46-51.