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SCAFFOLD LECTURING METHODS TO IMPROVE ENGLISH SECOND LANGUAGE SCIENCE STUDENT TEACHERS'ACADEMIC PERFORMANCE

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A growing problem in South Africa is that large numbers of first year Science students are not completing their study courses due to their inability to communicate effectively in English. The aim of the study is to investigate if scaffold-lecturing methods can improve students' academic performance. This article reports on both qualitative and quantitative data that was collected by using: a questionnaire with an open-ended question and comparing assessment results of three assignments and a test. First year (n = 136) Science student-teachers of a University in South Africa were divided into two classes, Class A and B, of which only Class A received scaffolding lecturing methods during the first semester of the academic year. These classes were lectured in their second language, English. Class A was lectured using visual, graphic, drawing and other scaffold techniques to explicitly teach academic content and to create opportunities in class where students can work through their language barrier and express their different viewpoints. Class B was lectured in the traditional way of power point and talk with no extra support. The assessment results of students attending scaffold lectures showed clear academic progress of their course work and an improvement in active class participation.

Keywords: Scaffold, Teaching methods, English 2nd language, Science, Academic progress..

Introduction

The linguistic, cultural and socio -economic diversity of first year students burdens tertiary institutions with students who are not English proficient and not able to acquire the content knowledge of their courses in a specific time frame (Freeman & Freeman, 2001). Jansen (2012) (rector of the University of Orange Free State) also states that "we worry, as university leaders, about the large numbers who drop out or repeat courses and years, simply because we made the mistake of believing that a pass in Grade 12 means a student is qualified to study at university". He elaborates that students also graduate from weaker universities with the same conceptual, communication and skill limitations with which they passed through school (Jansen, 2012). Thus, not all students are able to communicate successfully in English.

According to Duff (2000) and Coady (1997) the teaching methods teachers use to teach English in primary and secondary schools and students who use the English language less frequently at home (Taylor, Muller & Vinjevold, 2003) can most probably be blamed for some of the poor English communication skills of first year Science students. Okoro (2000) argues that

students who find it difficult to communicate effectively in English lectures, cannot successfully progress in tertiary institutions. Dale and Cuevas (1992) pointed out that Science requires a strong demand for language as language vocabulary is closely linked to students reasoning and problem solving abilities. Language acquisition, improving students' language production, background knowledge, and explicit teaching of academic language can all contribute to successful Science performance (Chomsky, 2000). Thus, education in South Africa not only needs to focus on a strategy on how to improve the 30 % passed rate for the final Grade 12 examination in 2011 (Department of Education, 2012) of Science students but also how to enhance their English proficiency to enable them to communicate in English and further their studies at tertiary institutions.

To achieve successful academic results at tertiary institutions, Brooks-Carson and Cohen (2000) are of the opinion that lecturers should apply intervention strategies in Science classes by designing scaffolding lectures to assist English second language(ESL) students.

The findings of this article are based on the information gained through a literature study and a research study that investigated if scaffold lectures can possibly improve first year ESL Science students' academic performance.

Background

South Africa's education system consists of Basic Education, which includes primary and secondary schools and Higher Education which embraces tertiary education. Post the democratic elections of 1994 many students flogged to white ESL instructing schools at the expense of mother tongue tuition, believing that English instruction would secure their employment and participation in the economics of the world (Ball, 2012). Thus, the value of mother-tongue instruction in early childhood and primary school, which lay: the foundation for successful learning and enables parents to communicate with teachers and assist their children's learning (UNESCO, 2010) were not always considered**.** Collier and Thomas (2002) elaborate by stating that literacy and fluency in the mother tongue lay a linguistic and cognitive basis for children learning additional languages. If students change to second language schooling, they may lose their first language proficiency and their interest and self-confidence may decline causing academic failure. In addition, Akinbote and Ogunsawo (2003) and Oluwole (2008) are of the opinion that mother tongue education in the primary schooling years of a child can preserve cultural values and beliefs, enable children to think, communicate and mentally translate all concepts taught.

Alexander (1967) states that each culture has its unique language through which the individual's perceptions of the world are expressed. Therefore, words used during Science instruction may have different cultural roots from those of the students' second language, English. For example, certain words that are essential to understand some Science concepts and to explain certain natural phenomena may not be available when a second language is the medium of instruction. Thus, learning of Science through a second language may pose a number of problems.

In 2005, the Grade 6 Systemic Evaluation National Report showed that those learning in their mother tongue achieved an average score of 69% in language, while those learning in a second language achieved 32% respectively (Support and Development Programme, 2012).

Furthermore, apart from parents enrolling their children in second language schools (depriving them of mother-tongue instruction), the cultural and political values of the country, the number of students excluded from the education system, availability of support structures and

the socio-economic status of students can also influence students' English proficiency (UNESCO, 2003). Opposing the importance of mother tongue instruction previous research of Ayodele (1988) and Falayajo (1997) indicate that poor academy achievement most probable originates from insufficient foundation English teaching.

Notwithstanding, the identification of possible factors that can contribute to inadequate English language proficiency, assessment results of first year (mostly disadvantaged) Science student teachers' English language proficiency at a University of South Africa indicate that these contributing factors have not been successfully addressed. First-year students' English language skills performances are expected to have a grading of Grade 12 or 12+. However, the assessment results showed that the English proficiency grading of all participants of this study, were graded on a Grade 8 level (Directorate of Support, 2012). As Science lectures will solely be in English, students may find it difficult to cope with English as second language, causing them to eventually fall behind or drop out from university (Kuper, 2003). A lack of Basic English can destroy students' self-esteem, as they are not capable to ask questions in class and lack confidence to communicate in English during class discussions (Nagata, 2004). Cohen (1998) points out that intervention in Science learning is important to restore students' lack of confidence by designing scaffolding lectures that will enable them to achieve successful academic results.

Scaffolding can be defined as the effective process by which an adult, a competent person or a peer assists students to perform an assignment beyond their current capability (Hammond, 2002 & Daniels, 2001). Scaffolding lecturers can be described as the structuring of Science assignments and course material in a way that students will be able to solve a problem, carry out an assignment, or achieve a goal with the assistance of the lecturer (Wood, Bruner & Ross, 1976).

Reiser (2004) maintains that using scaffolding lectures can support students and assist them to successfully perform certain assignments and allow them to shift to more compound assignments. Students, who are guided and scaffolded during lectures, can become more responsible, motivated and successful students (Vacca, 2008). However, De Vita (2001) indicated that students: have diverse levels of motivation, knowledge and skills, are from diverse cultures with different values and attitudes concerning teaching and learning, and pose different reactions to specific lecture environments and instructional strategies Therefore, the scaffolding strategy used by the students will differ, based on their language proficiency, culture, learning environment, skills and knowledge level.

Notwithstanding several researches stating the importance of scaffolding, Stone (1998) and Verenikina (2008) still question the effectiveness, credibility and the theoretical and practical value of scaffolding instruction. Verenikina (2008) argues that scaffolding can become an impediment rather than a support aid for children's development if taken out of its theoretical context. According to Stone (1998) there are still unrequited questions: What are the characteristics of students who are assisted by its application? Who is helped and who is not? How do limitations in language comprehension interfere with cognitive and communicative demands? Therefore, to find possible answers to some of the questions, this study will focus on the use of various scaffolding methods to assist ESL students, of diverse cultures to achieve successful academic results.

Instructional Scaffolding Methods

Saye and Brush (2002) distinguish between two levels of scaffolding lectures, namely: soft and hard. Soft scaffolding lectures, implies moment-to moment assistance, refers to a lecturer that circulates the lecture room, communicates, assists and gives feedback while students work on their assignments. Providing formative feedback on the assignments will assist students to master each step in the process before proceeding further. This type of scaffolding helps students get started on complex assignments early and ensures that they are on track throughout the lecture (Simons & Klein, 2007). While, hard scaffolds are planned in advance and used to assist students with a complicated assignment (Saye & Brush, 2002). For example, when students are executing experiments in the Science class, the lecturer may give hints or cues to assist them. Gibbons (2002), suggests that hard scaffolding should provide high levels of initial, deliberate, and well-planned support, which are gradually reduced as students progress towards independent learning. However, Davis and Miyake (2004) assert it is still the lecturer's responsibility to observe and decide when and how much support and assistance is needed and what methods will work best to include the diverse needs of all students.

From the author's experience and previous research the following scaffolding methods can be used for second language English students to master the content and language of the lecture:

Visuals: Stokes (2002) points out that thinking is impossible without image. Felder and Soloman (2001) elaborate that most people are visual students, and if sufficient visual content were included in learning materials students would retain more information as students become visual thinkers. Olson (1992) describes visual thinking as the processing of information through images rather than words. West (1997) states that visual thinking may be an advanced method used by students where they base their primary thoughts on images that are used to solve problems.

This ability of the student to link an idea with an image can be connected with concrete and creative thinking, while text interpretation is more abstract. Various visual scaffolding methods can be used in Science education, for example:

-*Graphical presentations:* Cifuentes and Hsieh (2004) and Earnshaw and Wiseman (1992) believe that concepts presented in different form of graphics by students are an important part of becoming a creative thinker (De Bono, 1995; Torrance & Safter, 1999). This implies that students should be able to construct and interpret charts, maps, graphs, and other visual presentations (tables, drawings, diagrams, flow charts, timelines, editorial cartoons, photographs, posters, videos, etc.) that are commonly used to supplement the content (Readence, Bean, & Baldwin, 2004). Learning with multiple visual representations has been recognised as a potentially powerful way of facilitating understanding of abstract concepts (Ainsworth & Van Labeke, 2002). Paivio (1986) a theorist of graphical literacy, states that if data is coded both verbally and visually, the chances of retrieval multiply. The reason being, that images are more likely to be coded both visually and verbally, whereas words are less likely to be coded visually. Thus, presenting images together with text can facilitate learning as images assist students to construct mental images that are essential for comprehending new information and enlarge the retrieval possibility of this information (Clark & Mayer, 2002).

- -*Drawing:* constructing and interpreting visual presentations in the form of drawings can be used as a "thinking activity" rather than a "drawing activity" to clarify the facts and theories of objects and natural phenomena (Forman, 1996). Drawing is used by students to express their understanding of a concept, generate ideas, get feedback from others, to reflect what they have observed, experienced, inquired about or are thinking about, facilitate problem

solving and construct their learning (Katz, 1998; Julie & Barbara, 1999). Drawing may help solvers advance their problem solving processes and it can sometimes give solvers the critical information that directly leads to problem solutions (Diezmann & English, 2001). Therefore, problem solvers should be able to make drawings themselves.

- *Differentiated assignments:* allow students to choose between different assignments that function as scaffolding to support students as they develop their critical thinking skills (De Jager, 2011). Commence with assignments that demand lower order critical thinking skills (observations, summaries or descriptions) and construct towards more complex assignments (case analysis, evaluate, problem solve).
- *One-minute paper:* instruct students to write a very short essay in-class, on the concepts that confuse them the most. This can be collected to determine students' level of understanding new concepts.
- *Interaction between ESL speakers and English speakers:* promote guided interaction among English second language-speakers and English speakers students by grouping them together and involve them in small group discussions or whole group discussions and activities.
- *Assessment:* ongoing, informal means of assessment should be utilised in every lesson to check for levels of understanding and skill development among students.
- *Concept map*: that helps students to summarise the content of a lecture by using keywords and sub-headings.
- *Reflection*: students use a short writing assignment that can either be written in class or at home to reflect back on the lecture. Reflection enables them to think about their own understanding of the content or patterns within it (developing a better understanding).
- *Set clear evaluation objectives*: Set clear objectives so that students understand the purpose of the assignment. Feedback should also be focused on these specific objectives. For example, if the lecturer objective is to develop students' critical thinking and argumentation skills, don't waste time correcting grammar and sentence structure.
- *Use hands-on activities:* design and carry out investigations, analyse data, draw conclusions and report findings to foster concept development. Hands –on and inquiry based activities can be a powerful medium to teach English language and literacy to diverse student cultures.
- *Written English activities:* activities written in English with translations in mother-tongue, summative assessment items to test for factual knowledge and direct instruction methods to implement new concepts (Genesee, Lindholm-Leary, Saunders, & Christian, 2006).
- *Mother tongue*: to communicate difficult concepts with one another can make a difference to learning (Kuper, 2003).
- *Criterion referenced assessment rubrics:* inform the lecturer on the individual growth and development of the student (Heath & Glen, 2005) and at the same time supplies students with self-assessment information and enhances motivation which is essential to progress.
- *Motivation:* is a powerful tool to improve learning skills (Ainley, 2004).
- *Culturally relevant texts:* use culturally relevant texts to engage students in active learning activities (Lee & Luykx, 2006).
- *Write about the topic:* let them write about a topic before you start discussing it (Tollefson, 1988).
- *Class discussions in small groups:* allow students to brainstorm, discuss, or complete a quick writing activity on topics/questions in small groups. This will help them to access new concepts, communicate with their peer and learn to respect each other's views.
- *Feedback:* regular realistic and timely feedback encourages student performances (Hill & Bjork, 2008).

- As students progresses academically and start working independently, scaffolding is gradually removed. Eventually, the students are allowed to independently practice the assignment or function without specific guidance.

Theoretical Orientation

Vygotsky (1978) postulates that support (scaffolding) from a knowledgeable person to a novice is important to acquire knowledge successfully. Thus, scaffold lectures as a strategy to improve the learning of new knowledge, derived from the socio-cultural theory of Vygotsky (1978). According to the socio-cultural theory, learning and cognitive development transpires from social interaction on an interpersonal level and is later processed to meaningful concepts by the student at the intrapersonal level. Vygotsky's (1978) zone of the proximal development (ZPD) postulates that social interaction allows students to build new knowledge from their experience, by moving from what they already know (actual development) to new knowledge (potential development). Clark and Graves (2005) summarise ZPD as the area between what students can do independently and what they need to do with assistance. Potential development among students contributes to the development of new knowledge and meaning of this acquired knowledge. Supporting this theory: Wertsch (1991) asserts that potential development as determined through problem solving under adult guidance, or in collaboration with more capable peers who believes that verbal interaction between students is important for them to acquire understanding of new concepts and skills; Franklin (1996) believes that three elements, interaction, zone of proximal development (ZPD) and mediation must exist for scaffold learning to take place successfully, Field (2004) depicts the connection between scaffolding and ZPD as: an adult that provides assistance to a developing child by drawing his attention in a assignment, direct him towards suitable goals, marking important characteristics of a assignment and indicating strategies that can be linked with one another.

The rationale for this study is that the findings will contribute to:

- the field of scaffolding instruction by assisting lectures to adopt new lecturing methods in their classes to improve their ESL students' learning with understanding and academic performance;
- lecturers that may also assist their students to find their ways to more interesting and meaningful learning and
- lecturers that may develop a clearer vision of their role as lecturer.

Research Design and Methods

Professional status of participating students

The professional status of the participants was first-year student teachers of a University of South Africa.

Data Collection Method

The research was based on both qualitative and quantitative data. The following methods were used to collect data: Quantitative study

Assignments

At the beginning of the first year students-teachers' study course, they were divided in two classes. Of these two classes only Class A (*n*=71) received scaffolding lecture methods during the first three lectures. While, Class B (*n*=65) received no scaffold lectures. The scaffolding methods that were used to support Class A were as follows:

- *First lecture*: the meanings of different concepts were explained, long word problems were rephrased in shorter sentences and key phrases were identified when solving a problem, difficult texts were pre-read, students were encouraged to use their mother tongue to explain difficult concepts to each other. Students reflected and summarised in English writing the new concepts they learnt during the lecture.
- *Second lecture:* visual aids, such as pictures, videos and photos were used to explain new concepts, students had to draw pictures on how they will solve the problem, real life examples were used, they had to identify key phrases and were challenged to write and create their own Science problems.
- *Third lecture:* Graphic presentations (tables, graphs etc) were used to explain ne content, a short class activity in writing was created where they had to review and criticize each others' work and value good writing and penalise bad writing, active class participation was encouraged by using debates, allowing them to criticise and discuss each others' point of view.
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Both the classes' (*n*=136) progress was assessed in the form of an assignment at the end of each lecture. Rubrics, which indicated clear assessment criteria, were used to assess the two classes' assignments. The assessment results of each assignment (*n*=3) was used to identify patterns of student errors, skills, and understandings. Class A (scaffold class) received immediate feedback in the following period; including specific steps, they can take for improvement in order to avoid the repetition of identified mistakes. Class B (no scaffold) received their assessment results two weeks later. The three assessment results of the two classes for the first three lectures were compared to determine significant changes in the academic performance of students when scaffold lecture methods were used. Test

Classes A and B wrote the same test after the three lectures to establish and compare any differences in the two classes' progress.

Qualitative Study

Questionnaires completed by student teachers

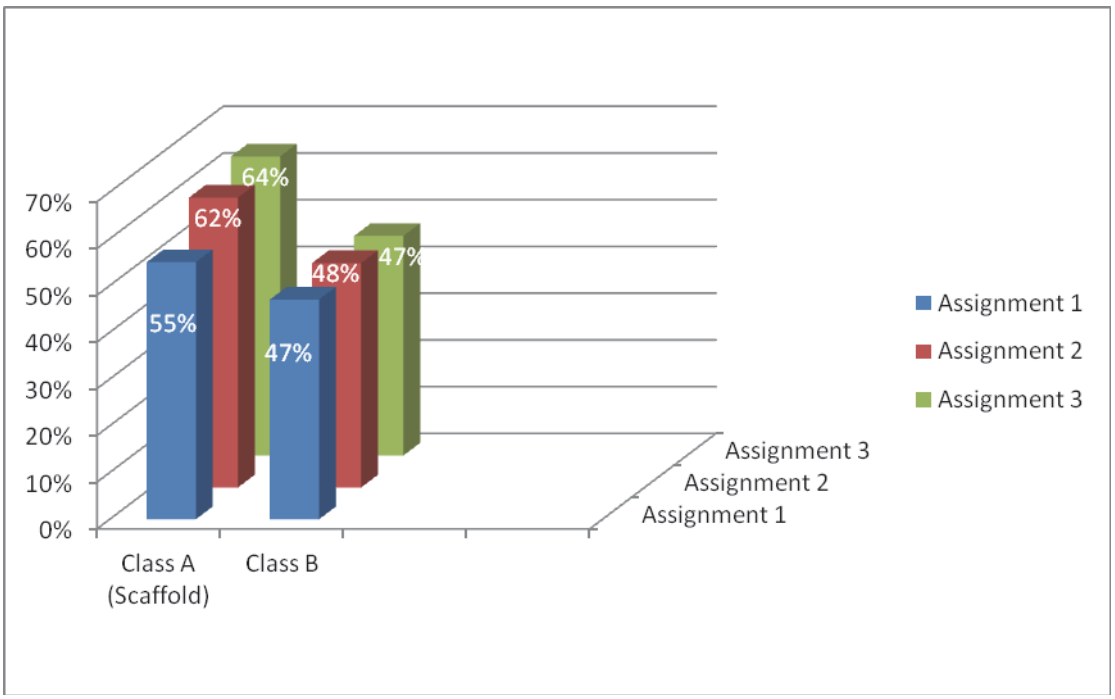
A questionnaire with an open-ended question was constructed for first year ESL Science student teachers at a University of South Africa. Participants' reflections were used to explore the influence of scaffolding methods on their academic performance. Only Class A (*n*=71) that received scaffold instruction was requested to complete the questionnaire.

Analysis of Data

Table 1 below reflects the students of Class A who were positively affected by scaffold lectures. Class A gained better scores than Class B for all assignments, 55% for assignment one, 62% for

assignment two, and 64% for assignment three. The reason for the lower score of assignment one can most probably be connected to the students' lack of English proficiency. The scaffold methods used during lecture one were mainly the explanation, rephrasing, highlighting of keywords of new concepts in English. Although students were allowed to explain unclear concepts in their mother tongue to one another, it seems that some of them explaining the concepts to other students did not understand the concept themselves. The higher scores for assignment two and three can most probably be linked to the visual and graphic presentations that were used to scaffold those lectures.

Table 1. Assignment results of Class A and Class B.

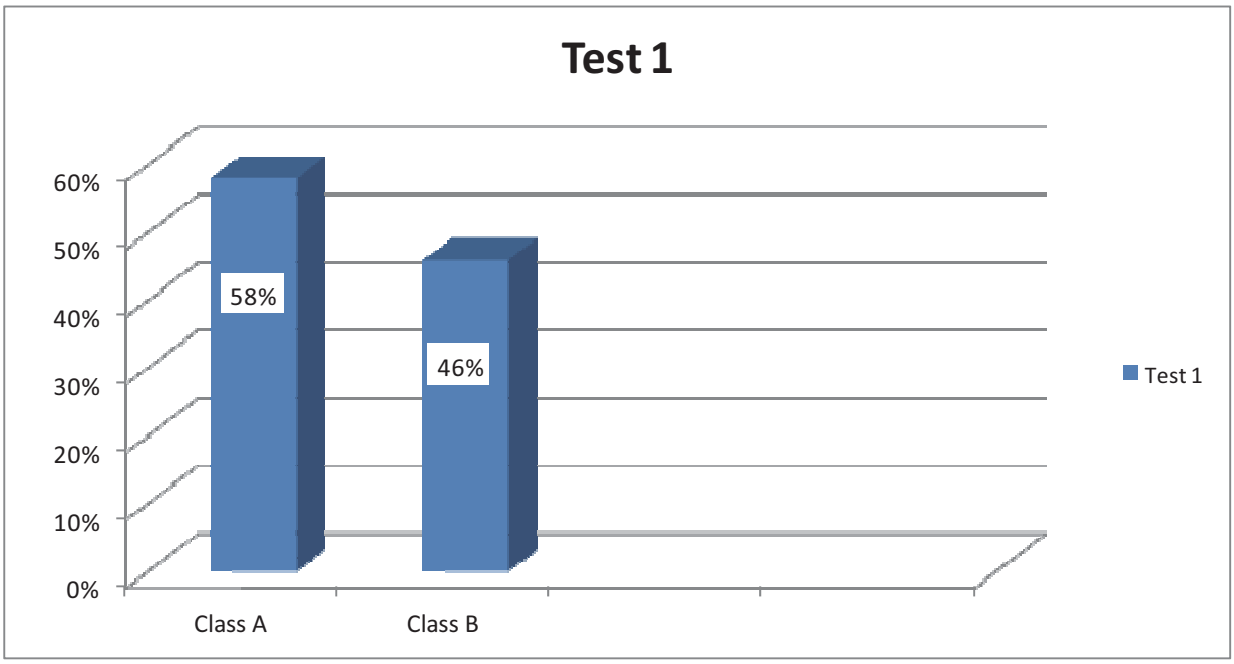


As not all students were English proficient, the mental identification of a concept with an image enhanced their learning ability. This finding can be related to researchers Stokes (2002) and West (1997) stating that visual thinking maybe used by students to base their primary thoughts on images to solve problems. Thus, the methods used to scaffold lectures can also influence student's scores. Another possible reason might be the quick feedback that Class A received on their assignments in order to prevent repetition of the same mistakes in the following assignment. Research of Hill and Byork (2008) confirms that regular and timely feedback can encourage student performances.

The significant differences in the scores of both groups showed that Class B received lower percentages in all three assignments, 47 % for assignment 1, 48% for the second assignment and 47% for the third. All these assessment results were failure averages, which indicated that the majority of students failed the first semester of their academic course. The reasons being that the lectures of class B (not proficient in English) were not scaffolded in the same way as Class A (visual aids, graphic presentations, drawings, active class presentations and others). As indicated previously, first year Science students were not English proficient therefore, they most probably did not understand the English lectures and could not always successfully learn new concepts. This indicates that scaffolding lectures has a considerable effect on students' of Class A's cognitive skills.

After the completion of the three assignments, both classes A and B wrote the same test based on the content of the three lectures. The assessed test results of the classes are illustrated in Table 2 below.

Table 2. Test results of Class A and Class B.



A comparative analysis of students' academic performance in both classes A and B indicated that there was a significant difference of 12% for the first test of their academic course. Class A scored 58% in the first test and Class B that did not receive scaffolding lectures, 46%. These findings can be justified based on the effectiveness of the scaffolding lectures that Class A received to support their lack of ESL proficiency. To avoid discrimination against Class B who did not receive scaffold methods, the test marks of both classes were not reported as evaluation marks for their course.

Questionnaires completed by student teachers

Responses to an open-ended question

The open-ended question was specifically designed to investigate student teachers' of Class A's perceptions of the influence of scaffolding lectures on the improvement of their academic performance. Class B did not complete questionnaires, as they did not receive scaffold lectures. Only one question was constructed in order to obtain objective answers, which were not influenced by sub-questions, directing them in a certain way. The most frequent comments of Class A, who received scaffold instruction, are grouped together according to their relevance to each other and quoted verbatim.

Question: "In what ways did various scaffolding methods (visual, drawing, keywords, active participation etc) during lectures improve your academic performance?"

Visual Scaffolding Methods

"The drawing activities helped me to understand concepts better".

"The lectures where the lecturer used visual aids really helped me to understand the concepts".

"The visual aids and hands-on activities really inspired me to learn".

These comments are in agreement with Stokes (2002), Soloman (2001) who point out that most people are visual students, and the understanding of new concepts is impossible without image.

Feedback

"Feedback of the lecturer helped me not to make the same mistakes in the next assignment".

"The assessment of my assignments and the lecturers support in class helped me a lot".

- The fact that Class A received immediate feedback after each assignment may have contributed that they scored higher marks in their assessments than Class B, which did not receive immediate feedback. Hill and Byork (2008) agree that if students receive regular realistic and timely feedback student performances will augment.

Mother Tongue

"I did not understand the new work at all, but when my friend explained it to me in my mother-tongue, I understood the terminology that the lecturer taught".

Of the participating students (n=68) indicated that they learn Science best when using mother tongue as a basis for communication in class. This finding supports the research of Hoven (2002) who points out that mother-tongue education can benefit disadvantaged groups and those from rural communities.

Language Proficiency

"I wrote a lot in class, I think my language structure really did improve".

"My English improved extremely, because my lecturer was using good English vocabulary in classes".

Most of the participants (n=58) reflected that English writing activities and the lecturers' English proficiency improved their English proficiency.

Small Groups

"Small group discussions increased my communication skills as I was able to practise my English with my peer, without them laughing at me".

"I love the class discussions, because then my friends can explain the concepts that I did not understand in the lecture to me"

"Class discussions improved my English as I had to explain certain concepts in the group"

Class discussions in small groups stimulated the students' prior knowledge and added to their dictionary by speaking up and exchanging information that included familiar words to some students that were new to others interchangeably.

Self-Esteem

"Because I participated in class discussions, my self-esteem and English improved and empowered me with more confidence to present practical lessons in front of my peer".

Encouraging students to present practical lessons in lectures not only improves their self-esteem but also contributes to the development of their English language proficiency.

Academic Progress

"My second assignment marks increased with 14% from the first assignment'

'My English improved, I am motivated to learn and my third assignment marks improved with 6% from my second assignment".

Comparing the test results of Class A and B there was a clear difference in scores of the two classes. Class A that received scaffold lectures scored an average of 12% higher than Class B.

Conclusion

Tertiary institutions are burdened with students who are not English proficient and not able to acquire the content knowledge of their courses in a specific timeframe. Assessment results of Science first year student teachers' in a University of South Africa showed that their English language proficiency measures on a Grade 8 level instead of a Grade 12 or 12+. As Science instruction will be in English, students may find it difficult to cope with English as second language, causing them to eventually fall behind or drop out from university.

In this study, the author used three scaffolding lectures to investigate if students' English proficiency and academic performance can improve. Science students were divided in two classes, A and B of which only Class A received three scaffold lectures, while Class B attended the same three lectures in other periods, without extra support. Class A was scaffold by: rephrasing sentences, identifying key phrases, explaining meanings of different concepts, rephrasing of long word problems in shorter sentences, pre-reading of difficult texts, encouraging of students to use their mother tongue to explain difficult concepts to each other, visual aids, such as: pictures, videos and photos were used to explain new concepts, students had to draw pictures on how they will solve the problem, Graphic presentations (tables, graphs etc) were used to explain new content, a short class activity in writing was created where they had to review and criticize each others' work, active class participation was encouraged by using debates, allowing them to criticise and discuss each others' point of view and others.

Assignments of Class A were marked and handed back as soon as possible, while class B had to wait three weeks for feedback on their assignments. Delayed feedback caused students of Class B to continuously make the same mistakes in all assignments that may have contributed to their low scores as illustrated in Table 1.

The assessment results for the first three assignments of Classes A and B were compared to explore significant changes in the academic performance of students when lectures were scaffolded. Class A scored higher marks than Class B for all three assignments and the test. The author realised that reporting these scores as part of the students' evaluation marks for their course would not be fair. Therefore, the scores were only recorded and utilised for the findings of this study.

Reflections of students on the open-ended question indicated that visual images and their mother-tongue language are important for them to understand new concepts and scaffolded lectures improved their self-esteem, academic performance and English communication skills.

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