Eurasia Journal of Mathematics, Science & Technology Education, 2014, **10**(2), 125-134

Using Problem-Based Learning to Stimulate Entrepreneurial Awareness Among Senior African Undergraduate Students

Arthur James Swart
Central University of Technology, South Africa

Received 26 June 2013; accepted 23 February 2014

Literature states that entrepreneurial awareness is required in countries where entrepreneurship is neither publicized nor acclaimed, which is currently the situation in South Africa. Entrepreneurial skills include the ability to market one's product by means of a sales poster while problem-based learning is viewed as fundamental to entrepreneurial education. The research question arises "How may academics use problem-based learning to stimulate entrepreneurial awareness among senior African undergraduate students?" The purpose of this article is to present a practical assignment which was designed to help students think about entrepreneurship while engaging in problem-based learning. Engineering students were asked to help resolve the problem of poor television reception in the Vaal Triangle community by designing and constructing a specific antenna and then designing a sales poster to market their product. Quantitative and qualitative data reveals that students are able to engage in problem-based learning in engineering, but lack the ability to design an effective sales poster which forms part of entrepreneurial skills. Results further reveal that students were able to meet the learning outcomes for this practical assignment and really enjoyed the problem-based learning approach.

Keywords: problem-based learning, entrepreneurship, sales poster, antenna design

INTRODUCTION

Thomas Edison reputedly said "Opportunity is missed by most people because it is dressed in overalls and looks like work". Entrepreneurship is a big opportunity that is missed by many people, as they know little about it or are afraid of taking risks due to the fluctuating economic environment (Rahmawati, Hasyyati, & Yusran, 2012). However, young people may be encouraged to take hold of this opportunity when they are exposed to the principles of entrepreneurship during their university studies, regardless of the field of study they pursue. Local entrepreneurship does, however, require training (Oviawe, 2010) which can lead to the success and welfare of a country or community (Zvirbule-Berzina & Gruzina, 2011). Entrepreneurship is fundamental to the growth of the economy in South Africa (SA) and its future socio-political stability (Fatoki, 2010).

SA currently faces severe socio-economic problems, such as poverty and unemployment. However, black adolescents from a variety of backgrounds in SA indicate that a strong desire exists to escape the trappings of poverty and unemployment (Kamper & Badenhorst, 2010). One way to help students fulfill this desire is to stimulate entrepreneurial awareness, while at the same time developing their problem-solving skills. The ability to reason effectively and to solve problems creatively are skills that must be acquired through appropriate instruction and training (A. J. Swart, 2010). Problem-based learning has helped students to conceptualize different engineering fundamentals

Correspondence to: Arthur James Swart,
Central University of Technology
Private Bag X20539, Bloemfontein, South Africa, 9300, Tel: +27 51 507 3709
E-mail: drjamesswart@gmail.com
doi: 10.12973/eurasia.2014.1023a

ISSN: 1305-8223

State of the literature

- Entrepreneurial awareness is required in countries where entrepreneurship is neither publicized nor acclaimed
- Entrepreneurial skills include the ability to market one's products by means of a sales poster
- Problem-based learning is viewed as fundamental to entrepreneurial education

Contribution of this paper to the literature

- The current climate faced by entrepreneurs in South Africa is highlighted along with the need for students to become self-sufficient
- How to stimulate entrepreneurial awareness among senior undergraduate students enrolled for an engineering qualification is substantiated
- Results reveal that students were able to meet the learning outcome for this practical assignment and really enjoyed the problem-based learning approach

(Bhatti & McClellan, 2011; Santos-Martin, Alonso-Martinez, Eloy-Garcia Carrasco, & Arnaltes, 2012) in order to develop holistically acceptable solutions to engineering problems (Ribeiro & Mizukami, 2005) and has been seen as core to the entrepreneurship teaching field (Bager, 2011). It further helps to positively affect attitudes of students in relation to such areas as problem-solving, thinking, group work, communication, information acquisition and information sharing with others (Akınoğlu & Tandoğan, 2007).

Problem-based learning is used extensively in National Diploma courses on Electrical Engineering in SA, where students need to complete approximately 22 subjects over a two year period. An additional year must be spent working in Industry, where students can put into practice the theoretical knowledge which they have acquired. This additional year of vocational training may be referred to as work based experience or work integrated learning (WIL) which is mandated by the Engineering Council of South Africa (ECSA), a statutory body responsible for promoting a high level of education and training of practitioners in the engineering profession (ECSA, 2014). However, many African undergraduate students battle to secure employment where they can complete their WIL, and subsequently end up at home for months on end generating no financial income for them or their families, thereby making no significant contributions to socio-economic development. Even worse is the fact that these students cannot even graduate until they have completed their WIL. This in turn has a knock on effect on the quality of life that these students enjoy, as their income or promotion opportunities depend largely on their qualifications. Stimulating entrepreneurship among these students may assist them in obtaining work based experience, thereby enabling them to become self-sufficient, or at least help them to care for their basic human needs when returning to their local communities. Establishing and running their own Small Medium and Micro Enterprise (SMME) may even lead to their being credited the WIL component, leading to their graduation.

The research question which arises in this case is "How may academics use problem-based learning to stimulate entrepreneurial awareness among senior African undergraduate students?" The purpose of this article is to present a practical assignment which was designed to help students think about entrepreneurship while engaging in problem-based learning. Descriptive statistics is used along with time-lag study which is discussed under the research methodology section. The target population is restricted to all students who enrolled for a telecommunications subject (Radio Engineering 3 or RAE3) during 2011 and 2012. A brief overview of this course is given in the article with the results depicted in a series of tables and graphs. Rationale for stimulating entrepreneurial awareness among senior African engineering students is firstly presented.

Why Entrepreneurial Awareness?

The Oxford Dictionary (2013) defines an entrepreneur as "a person who sets up a business or businesses, taking on financial risks in the hope of profit". Linda Pinson, author and creator of business plan software, defines an entrepreneur as a person who starts a business to follow a vision, to make money, and to be the master of his/her own soul (both financially and spiritually) (Pinson, 2013). Inherent in the venture is the risk of what the future may bring. According to Anayakoha (2006), an entrepreneur is one who chooses or assumes risks, identifies a business opportunity, gathers resources, initiates actions and establishes an organization or enterprise to meet such demand or market opportunity. From these definitions it becomes clear that an entrepreneur must be able to recognize the need for a specific product or service within a given community, acting upon this need by gathering relevant resources to manufacture the product or deliver the service. However, many engineering students in SA do not think along the lines of entrepreneurship, which may be due to the following two reasons. Firstly, entrepreneurship is not well advocated or acclaimed in SA and secondly, entrepreneurial educational is often confined to business related fields.

Lerner and Haber (2001) state that entrepreneurship is stimulated by culture, human capital, legislation, and the connecting networks formed with different

stakeholders and with support from State institutions. However, Sunter (2013) commented that entrepreneurs currently face a hostile environment in SA. In many developed countries the red carpet is rolled out for entrepreneurs, while in SA, red tape is rolled out for them. A case in point is Siyabulela Xuza (South African Consulate General, 2013) and Jack Andraka (Tucker, 2012). As a teenager, Siyabulela developed a new rocket fuel for which he received numerous international awards, receiving very little publicity or acclaim in SA. On the other hand, teenager Jack Andraka developed a new, rapid, and inexpensive method to detect pancreatic, ovarian, and lung cancer, receiving much publicity and acclaim in America. Publicity is viewed as more trustworthy based on the perception of news media as non-manipulative and more objective with its goal being to create awareness, change attitudes, and influence behavior (Lee, Hwang, & Yeh, 2013). Subsequently, when State institutions and communities openly publicize and praise individual entrepreneurial accomplishments, then entrepreneurship is encouraged and promoted. The converse is also true; a little publicity or acclaim leads many to view entrepreneurship as non-essential or as a non-priority area. This has even occurred in specific fields of study, such as in science education in the Soviet Union, where the main objective was the recruitment and exacting preparation of a maximum number of future scientists and engineers, with little focus on science education for entrepreneurship (Kapanadze & Eilks, 2014).

Students in scientific disciplines often perceive business related and entrepreneurship topics as non-priority areas, remaining "peripheral" rather than "core" to their programme of study (Henry & Treanor, 2012). This implies that many engineering students are not exposed to the principles of entrepreneurship, as they concentrate solely on subjects or modules within their relevant field of study. They therefore develop no real entrepreneurial skills, such as creativity, innovation and flexibility (Rahmawati, et al., 2012), risk-taking and ability to interpret successful entrepreneurial role models and identification of opportunities (Fatoki, 2010), creative problem-solving, persuading, negotiating, selling, proposing, holistically managing business or projects, strategic thinking and intuitive decision-making (Gibb, 2006). The development of these skills is often incorporated into dedicated subjects on entrepreneurship, which in many cases is a voluntary offering for students in engineering. Furthermore, the majority of research studies conducted to date on the teaching of entrepreneurship are focused within traditional and mainstream business disciplines (Hannon, 2007). Subsequently, more undergraduate students need to be made aware of entrepreneurship and its benefits.

How May Entrepreneurial Awareness Be Stimulated?

The integration of entrepreneurship education should be practically oriented (Olarewaju, Folashade, & Ademola, 2013). Entrepreneurship skills which can be practically acquired includes the ability to take initiative and creatively seek out and identify opportunities; develop budgets, project resource needs and potential income; communicate effectively and market oneself and one's ideas (Awogbenle & Iwuamadi, 2010). This last skill, namely marketing one's ideas, can easily be accomplished through flyers, posters in public places, wide-ranging personal contact, community events, and partnerships with local authorities or other associations (Smith & Blumenthal, 2013).

White (2012) states that an effective sales poster should quickly arrest the attention of the viewer, deliver a swift clear message, effectively accomplish a goal, convince and persuade the audience, and move them to action. The attention of the viewer should therefore be captured by a bold key phrase and not include jargon or too much theoretical details. It should have the goal of presenting a needed product, at an affordable price with relevant contact numbers. It should persuade the viewer that the product or service is required, moving the viewer to call the number listed on the sales poster. Sales posters should therefore:

Address a need of a specific community or individual;

Indicate whether the item / service is affordable;

Direct the public to a specific person to acquire the product; and

Be attractive, colorful and uncluttered.

Engineering academics at the Vaal University of Technology (VUT) decided to use a practical assignment or project, within the subject RAE3, where students had to design and construct a specific antenna to address a local need within the Gauteng region (Vaal Triangle community) in SA, that being poor E-TV (a national television broadcast station) reception. Entrepreneurial awareness was to be primarily stimulated by the design of a sales poster marketing their antenna.

Radio Engineering Iii Structure And Assignment

RAE3 is a voluntary offering or subject for the National Diploma: Engineering: Electrical qualification, comprising approximately 22 subjects in total. This subject is usually offered during the final semester (approximately 14 weeks in duration) of the diploma course and builds on previously acquired knowledge in the field of telecommunications. This subject is specifically designed to aid students to understand radio station broadcasts and reception principles with regard to frequency generation (A. J. Swart, Schoeman, & De

Jager, 2006), modulation (A.J. Swart, 2012a), transmission and antenna design principles. Ten practical assignments are included in the curriculum to help students to bridge the gap between theoretical and practical instruction. These practical assignments further enables students to exercise engineering judgment and apply it to a practical problem (Ibrahim, 2004). RAE3 encourages group work where two students work together on a series of assignments that promotes cooperative learning (Zakaria & Iksan, 2007) which is, in various aspects, a very superior education methodology compared to other traditional ones (Martinez, Herrero, & De Pablo, 2011).

Students enrolled at VUT for the National Diploma in Electrical Engineering are given preference to the RAE3 laboratory. However, there are a number of weekends in the year where the laboratory is opened to students enrolled for this course at the University of South Africa (UNISA). This is due to the fact that UNISA is an open distance learning institute which has just recently established a number of engineering laboratories which needs to be equipped with relevant electronic and engineering equipment. Students from both VUT and UNISA are therefore exposed to the practical assignments in the RAE3 laboratory, including the antenna practical (see Figure 1 – verbal permission was granted by the students to take their photograph for presentation of evidence to public authorities or accreditation bodies).

The antenna practical involves problem-based learning where students need to demonstrate one primary learning outcome, being the design and construction of a Yagi-Uda antenna for E-TV reception in the Vaal Triangle community. The practical assignment must meet the following assessment criteria:

The antenna must receive E-TV with an acceptable signal to noise ratio;

The antenna must include a singular wooden beam, nine aluminium rods and a 2 m RG59 cable (see Figure 1);

The antenna sketch must be fully labelled and according to a given scale (see Figure 2);

The antenna sales poster must be presented via a flash drive in software format (see Figure 3).

The constructed antenna (including the feed line – see Figure 1), the sketch (which must be to scale – see Figure 2) and sales poster (a software copy – see Figure 3) needs to be submitted for assessment. Peer review assessment is used to judge the quality of reception of the antenna by connecting it to a LCD television set which is pre-set to receive E-TV. Students judge the quality of reception based on the amount of noise, snow and audio interference. Oral assessments are used to appraise the construction of the antenna, with specific reference to weather proofing and installation techniques. Criterion-referenced assessment is used to evaluate the sketch where the facilitator primarily measures the antenna elements with a ruler to determine scaling accuracy. The sales poster is also assessed orally (see Figure 3 for an example) with regard to structure, neatness and visibility!

Figures 1 to 3 provide important evidence of students completing the practical assignment and thereby ensuring authentic assessment and quality control of the subject's curriculum. These photographs serve two important purposes, namely providing evidence of learning to ECSA and providing proof that the learning outcome of the practical assignment has been achieved by the students. The mission statement of ECSA states in part that persons wishing to enter the engineering profession be educated and trained according to widely accepted standards, in order to be able to render a professional service for the benefit of the public and the country as a whole (ECSA, 2014). ECSA is therefore concerned with what a person knows

Figure 1. Students from UNISA with their completed Yagi-Uda antenna

and with what a person can do (A.J. Swart, 2010). Improving hand-eye fine motor skills of African engineering students are high on the priority list in SA and includes working with measuring tapes, saws, drills, screwdrivers, side cutters, pliers and hammers, which all formed part of this practical assignment in RAE3.

RESEARCH METHODOLOGY

This research involves a time-lag study where the perception of students, from different semesters or academic years, are obtained regarding a particular situation or notion (Goddard & Melville, 2006). RAE3 student's (this being the target population) perception of a practical assignment involving problem-based learning (which incorporated the design of a sales poster as part of entrepreneurial awareness) was obtained for the 2011 and 2012 academic years by means of an on-line questionnaire. This primary measuring instrument (the questionnaire) involves mainly objective data and is also an inexpensive way of collecting data (De Vos, Strydom, Fouché, & Delport, 2005). It was completed on-line (via the SAKKAI learning management system) at the end of the semester, once all students had completed the practical assignments in the laboratory. Perceptions of these students are sought regarding the practical assignment on antenna design, as well as the effectiveness and usefulness of the practical instruction (this is primarily qualitative data). Having all the enrolled students complete the questionnaire negates the need for a sampling technique. Quantitative data is presented in the form of student grades for this practical assignment, grades which need to be higher than 70% (14 out of 20) to show that the learning outcome and assessment criteria were met.

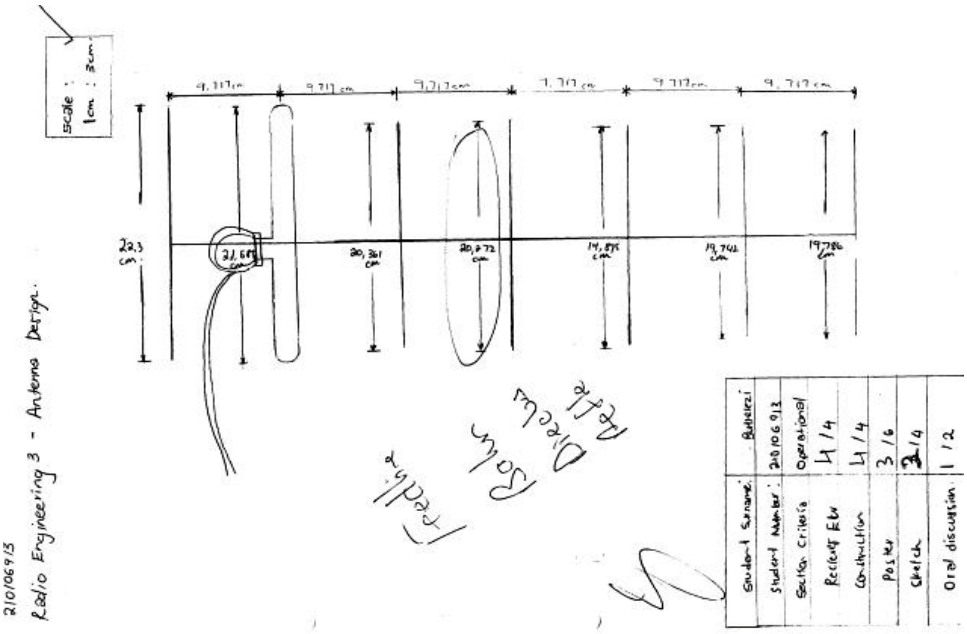

Figure 2. Antenna sketch

Figure 3. Student poster from 2011

FINDINGS AND INTERPRETATIONS

The questionnaire comprised ten questions relevant to this research, two of which were open-ended questions. A Likert scale approach was used with five of the closed-ended questions appropriate to this research, where students were given a choice between strongly agree, agree, undecided, disagree and strongly disagree (see Figure 4). Three other closed-ended questions (yes or no option available) required the respondents to select if the antenna practical assignment was challenging, enjoyable and relevant to the theoretical instruction provided in the classroom (see Figure 5).

Figure 4 clearly indicates that the majority of respondents felt that the learning experience in RAE3 was very valuable, having assisted them to apply new knowledge in solving an engineering problem. Working in small groups was also rated a valuable learning experience. This satisfies a number of exit level outcomes specified by ECSA as well as critical cross field outcomes specified by the South African Qualifications Authority (SAQA) (A.J. Swart, 2012b). These outcomes include problem solving, research, engineering design, management and communication. Noteworthy is that more than 50 out of the 67 respondents indicated that they would encourage other students to take this subject.

Figure 5 furthermore shows that only two students found the practical assignment difficult to complete, while more than 40 out of the 67 respondents indicated that they enjoyed the practical and found it relevant to the theory discussed in the classroom. Fusing theory and practical in a curriculum in engineering education is also fundamental to satisfying ECSA requirements (A.J. Swart & Sutherland, 2007), helping students to develop necessary cognitive and fine motor skills. The home languages (shown in Figure 6) of the respondents were also sought in order to highlight the student profile at VUT.

The student profile comprises a large contingency of French (mainly foreign students from the DRC) and Sesotho (originating mainly from the Free State Province in SA) speaking students. This student profile is very different to the student profile of the 1990's, which comprised many English and Afrikaans speaking students, thereby necessitating the introduction of new

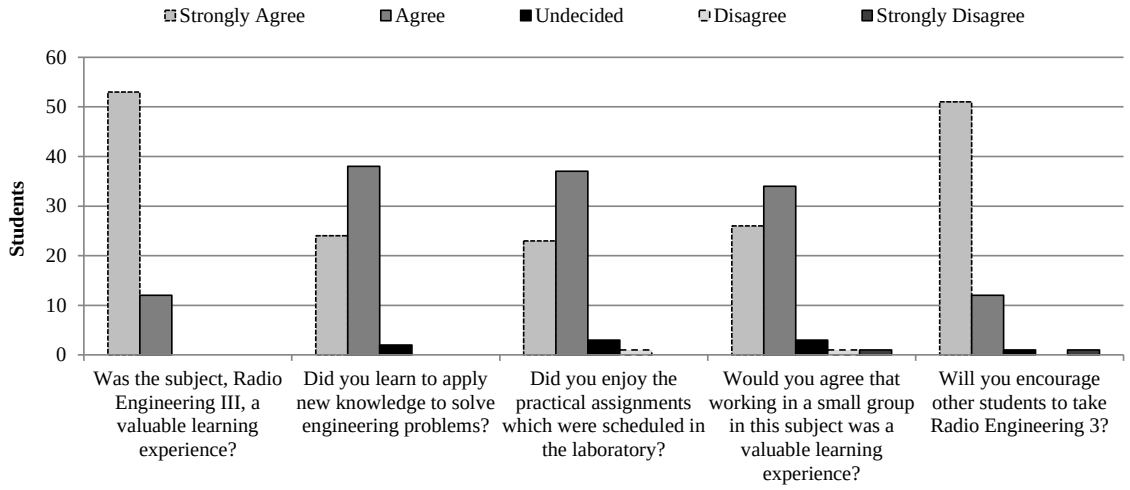

Figure 4. Five closed-ended questions for 2011 and 2012 featuring the Likert scale

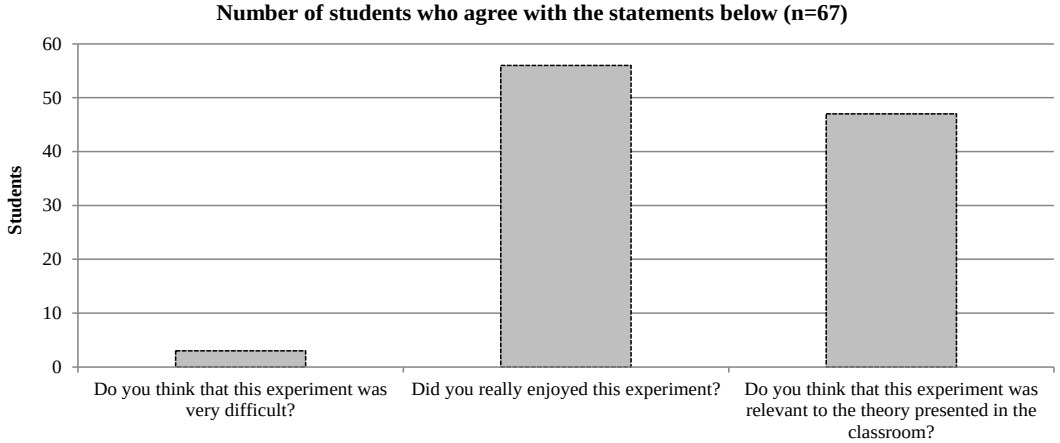

Figure 5. Questions regarding how challenging, enjoyable and relevant the practical was

teaching strategies and learning styles to accommodate these diverse students. Table 1 presents the responses of students to two of the open-ended questions relating to what the students really enjoyed about the subject and how they felt about the lecturer. The number of times these thoughts were expressed by the different respondents is shown under the frequency column. Noteworthy are the comments regarding enjoying practical work done in the laboratory, which accounts for almost 50% of the respondents. This indicates that many students prefer a learning style which is more sensory based (sights relating to the material and sounds relating to the drilling machine and hand saw) with both visual and auditory inputs. Students organize the information inductively, having been given facts from which important TV reception principles are discerned. They process the information more actively and come to understand the sequential step-by-step progression of the construction of the antenna. The preferred learning style of these students therefore includes sensing/visual/auditory/inductive/active/sequential components. Felder and Silverman made the point that most engineering students have a sensing, visual, inductive and active learning style (Felder & Silverman, 1988) which needs to be accommodated by the lecturer to meet the learning needs of the students. Many of the respondents (40 out of 67) further indicated that the lecturer succeeded in fulfilling his teaching and learning responsibilities in the transfer of knowledge and skills in a way that benefitted them. Figure 7 highlights a histogram of the grades achieved by the students over a two year period for this practical assignment on antenna design.

Figure 7 indicates that the students were able to achieve the learning outcome and meet most of the assessment criteria, as the majority of the grades were 70% or more (14 out of 20 possible marks). This is also indicated by the cumulative percentage which indicates that less than 30% of the students achieved less than 70% (13 out of the possible 20 marks).

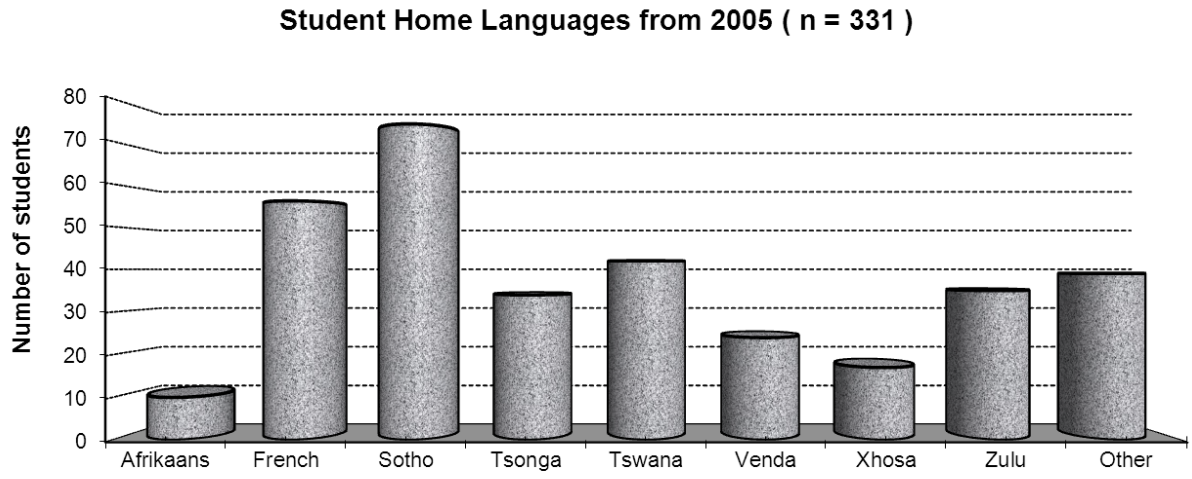

Figure 6. Home languages of the respondents enrolled for RAE3 from 2005 through 2012

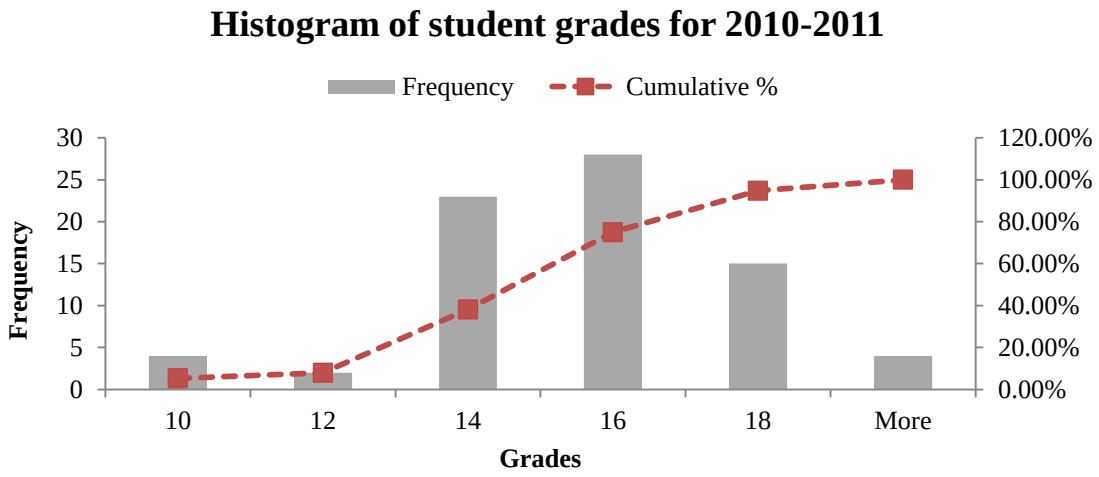

Figure 7. Student marks for the antenna practical assignment

Table 1. Student responses to the open-ended question regarding what they really enjoyed and how they felt about the lecturer.

Response	Frequency (n = 67)
I enjoyed the practical in the laboratory	32
I enjoyed the antenna design	14
The lecturer was good / great / excellent	40

DISCUSSIONS

Entrepreneurial skills include the ability (1) to perceive an opportunity, (2) to act on that opportunity (Audretsch & Link, 2012) and (3) to market one's idea or product (Awogbenle & Iwuamadi, 2010). First, an opportunity was identified by the academic to help residents of the Vaal Triangle community resolve problems associated with poor E-TV reception by providing a much needed product, a specific antenna. Second, engineering students acted on his opportunity by designing and constructing their own Yagi-Uda antenna (as part of problem-based learning – Figures 1 and 2). Third, these students then designed their own sales poster of the antenna for marketing purposes (hereby stimulating entrepreneurial awareness – Figure 3). Engineering students were therefore able to demonstrate two out of the three entrepreneurial skills presented in this article by means of problem-based learning, with the most important being that of the sales poster design.

A number of students indicated that they really enjoyed the practical assignment which was relevant to the theory (see Figure 5), having been assisted to apply new knowledge in solving an engineering problem (see Figure 4). The positive feedback given by students (shown in Figure 4) further reveals that problem-based learning does indeed positively influence student attitudes towards group work and information sharing with others, something which was noted by Akınoğlu and Tandoğan (2007). Some additional direct comments received included "I enjoyed the most the designing of the Yagi-Uda Antenna, it was so nice to see something made by myself that is working and every one could see that he was working properly" and "I enjoyed mostly the antenna design. I couldn't wait for my antenna to receive E-TV". These comments indicate that the problem-based learning assignment was meaningful in that it achieved a measurable outcome, that of seeing the antenna working correctly. The basis of learning is not the amount of content learnt, but the degree of autonomy and the level of meaningfulness with which students learn (Caballero, Blanco, & Guerrero, 2011).

The outcome for this problem-based learning assignment was achieved (grade marks shown in Figure 7) and the assessment criteria for the antenna was met, which included receiving E-TV with an acceptable signal to noise ratio and designing a sales poster for marketing purposes. However, student ability to design an effective sales poster required attention. For example, consider Figure 3 where a student's sales poster is depicted. No mention is made of the sale of the antenna or of its purpose. This is necessary to capture the attention of a passer-by in a street crowd which is an essential requirement of a poster (Lunding, 2013). Mention is rather made of a Yagi-Uda antenna for 679.25 MHz. The lecturer often asked the students if their grandmother would know Yagi-Uda or if she would know what 679.25 MHz means. They always respond in the negative. So the point is made that if their grandmother does not know these terms, then the public at large would also not know, and subsequently would not take notice of their product which they are offering. This reasoning helps students to identify a key criteria for the sales poster, namely that it must feature words that are familiar to their community and address a need that they have (in this example, good reception of E-TV). Subsequently, students come to understand that the most important words that are missing are "E-TV antenna for sale". Other concerns, which were orally discussed, include:

The dark background which would consume too much ink and raise the printing costs;

The price needs to be enlarged so as to be more visible;

No contact person is mentioned, although a number is given which needs to be enlarged; and

The picture of the city on the left is maybe irrelevant and consumes necessary space.

However, what is good about the poster is the fact that the student displayed initiative in using different bright colors, including a clear picture of the antenna, stating "while stocks last" and giving a special bonus of a free installation. Overall this is one of the better posters received from more than 30 submissions over a two year period.

CONCLUSIONS

The purpose of this article was to present a practical assignment (using problem-based learning) which was designed to stimulate entrepreneurial awareness among senior African undergraduate students. The structure of the practical assignment was explained along with the problem that students have to solve within the Vaal Triangle community, that of poor E-TV reception.

Feedback from undergraduate students regarding this problem-based learning approach incorporating entrepreneurial principles revealed that students:

Enjoyed the practical; especially constructing something that works;

Interacted with the lecturer, analyzing their sales poster for deficiencies;

Developed necessary hand-eye fine motor skills to satisfy ECSA requirements;

Associated a design on paper with a finished product (cognitive skills);

Verified the operation of their antenna with a TV set; and

Viewed the practical as an important learning curve.

Stimulating entrepreneurial awareness should be the mandate of all academics, irrespective of their field of discipline. This could be done within any academic subject by means of a short lesson on entrepreneurial principles and its benefits, or by including a project or assignment where students need to address a particular need within their community by using their acquired knowledge, or by having students design a sales poster to market their product. This singular entrepreneurial principle may be all that is required to stimulate entrepreneurial awareness among students in any field of study. In this specific subject, being RAE3, focus was primarily directly to the design and construction of a much needed antenna (using problem-based learning) and its marketing by means of a sales poster (a sales poster design is but one entrepreneurial skill which may stimulate awareness). Evidence of competency was gathered in terms of a formative assessment (oral and peer assessment of the antenna), summative assessment (criterion-reference assessment of the design and the poster) and student feedback (questionnaire). The final grades of the students completing this practical assignment indicates that most students could meet the assessment criteria, and subsequently the learning outcome of the assignment, while their feedback reveals their satisfaction with their lecturer and their own work. Stimulating entrepreneurial awareness among senior African undergraduate students, by using problem-based learning, has resulted in creating a more realistic true-to-life working experience, producing a more holistic student and possibly contributing to the socio-economic upliftment of students returning to their communities.

REFERENCES

Akınoğlu, O., & Tandoğan, R. Ö. (2007). The Effects of Problem-Based Active Learning in Science Education on Students' Academic Achievement, Attitude and Concept Learning. *Eurasia Journal of Mathematics, Science & Technology Education, 3*(1), 71-81.

Anyakoha, E. U. (2006). *Practical tips for economic empowerment and survival.* Nsukka: AP Express.

Audretsch, D. B., & Link, A. N. (2012). Valuing an entrepreneurial enterprise. *Small Business Economics, 38*(2), 139-145.

Awogbenle, A. C., & Iwuamadi, K. C. (2010). Youth unemployment: Entrepreneurship development programme as an intervention mechanism. *African Journal of Business Management, 4*(6), 831-835.

Bager, T. (2011). The camp model for entrepreneurship teaching. *International Entrepreneurship and Management Journal, 7*(2), 279-296.

Bhatti, P. T., & McClellan, J. H. (2011). A Cochlear Implant Signal Processing Lab: Exploration of a Problem-Based Learning Exercise. *Education, IEEE Transactions on, 54*(4), 628-636.

Caballero, A., Blanco, L. J., & Guerrero, E. (2011). Problem Solving and Emotional Education in Initial Primary Teacher Education. *Eurasia Journal of Mathematics, Science & Technology Education, 7*(4), 281-292.

De Vos, A. S., Strydom, H., Fouché, C. B., & Delport, C. S. L. (2005). *Research at Grass roots: for the Social Sciences and Human Service Professions* (3rd ed.). Pretoria: Van Schaik Publishers.

ECSA. (2014). Home Page. Retrieved 05 January, 2014, from http://www.ecsa.co.za/

Fatoki, O. O. (2010). Graduate entrepreneurial intention in South Africa: Motivations and obstacles. *International Journal of Business and Management, 5*(9), P87.

Felder, R. M., & Silverman, L. K. (1988). Learning and teaching styles in engineering education. *Engineering education, 78*(7), 674-681.

Gibb, A. (2006). *Entrepreneurship: Unique Solutions for Unique Environments. Is it possible to achieve this with the existing paradigm?* Paper presented at the Background Paper to the Plenary Presentation to the International Council for Small Business World Conference.

Goddard, W., & Melville, S. (2006). *Research Methodology: An Introduction* (2nd Edition ed.). Lansdowne: Juta & Co.

Hannon, P. (2007). Enterprise for all? The fragility of enterprise provision across England's HEIs. *Journal of Small Business and Enterprise Development, 14*(2), 183 - 210.

Henry, C., & Treanor, L. (2012). Exploring entrepreneurship education within veterinary medicine: can it be taught? *Journal of Small Business and Enterprise Development, 19*(3), 484-499.

Ibrahim, E. S. (2004). Student design projects in King Abdulaziz University for power engineers. *International Journal of Electrical Engineering Education, 41*(3), 216-229.

Kamper, G., & Badenhorst, J. (2010). Facing the Future: The Perceptions of Black Adolescents on their Prospects in South Africa. *Journal of Asian and African Studies, 45*(3), 243-257.

Kapanadze, M., & Eilks, I. (2014). Supporting reform in science education in Central and Eastern Europe-reflections and perspectives from the project TEMPUS-SALiS. *Eurasia Journal of Mathematics, Science & Technology Education, 10*(1), 47-58.

Lee, C.-H., Hwang, F.-M., & Yeh, Y.-C. (2013). The Impact of Publicity and Subsequent Intervention in Recruitment Advertising on Job Searching Freshmen's Attraction to an Organization and Job Pursuit Intention. *Journal of Applied Social Psychology, 43*(1), 1-13.

Lerner, M., & Haber, S. (2001). Performance factors of small tourism ventures: The interface of tourism, entrepreneurship and the environment. *Journal of Business Venturing, 16*, 77-100.

Lunding, E. (2013). The 1920s Silent Movie Poster Collection at Kungliga biblioteket, The National Library of Sweden. *Journal of Design History, 26*(3), 321-330.

Martinez, F., Herrero, L. C., & De Pablo, S. (2011). Project-Based Learning and Rubrics in the Teaching of Power Supplies and Photovoltaic Electricity. *Education, IEEE Transactions on, 54*(1), 87-96.

Olarewaju, O., Folashade, O., & Ademola, M. (2013). Enterprenership education: a panacea for secondary schools transformation in Nigeria. *European Journal of Educational Sciences, 1*(1), 46-52.

Oviawe, J. I. (2010). Repositioning Nigerian Youths for Economic Empowerment through Entrepreneurship Education. *European Journal of Educational Studies, 2*(2), 113-118.

Oxford Dictionary. (2013). Retrieved 21 October, 2013, from http://www.oxforddictionaries.com/

Pinson, L. (2013). Focusing on Business Excellence. Retrieved 10 May, 2013, from http://www.business-plan.com/

Rahmawati, F., Hasyyati, A., & Yusran, H. L. (2012). *The obstacles to be Young Entrepreneur*. Paper presented at the The 2012 International Conference on Business and Management.

Ribeiro, L. R. C., & Mizukami, M. G. N. (2005). Problem-based learning: a student evaluation of an implementation in postgraduate engineering education. *European Journal of Engineering Education, 30*, 137-149.

Santos-Martin, D., Alonso-Martinez, J., Eloy-Garcia Carrasco, J., & Arnaltes, S. (2012). Problem-Based Learning in Wind Energy Using Virtual and Real Setups. *Education, IEEE Transactions on, 55*(1), 126-134.

Smith, S. A., & Blumenthal, D. S. (2013). Translating Research to Practice. In D. S. Blumenthal, R. J. Diclemente, R. Braithwaitte & D. Smith (Eds.), *Community-Based Participatory Health Research: Issues, Methods, and Translation to Practice* (2nd ed.). New York: Springer Publishing Company.

South African Consulate General. (2013). Home page. Retrieved 22 September, from http://www.southafrica-newyork.net/consulate/siyabulela.html

Sunter, C. (2013). *The world and South Africa beyond 2013. As a Fox sees it*. Paper presented at the SAUPEC 2013, Spier Hotel, Stellenbosch.

Swart, A. J. (2010). Does it matter which comes first in a curriculum for engineering students – theory or practice? *International Journal of Electrical Engineering Education*, *50*(2), 257-264.

Swart, A. J. (2010). Evaluation of Final Examination Papers in Engineering: A Case Study Using Bloom's Taxonomy. *IEEE Transactions on Education, 53*(2), 257-264.

Swart, A. J. (2012a). Enhancing students' perception of single-sideband suppressed-carrier principles by using cooperative and computer-based learning. *Computer Applications in Engineering Education, 20*(2), 332-338.

Swart, A. J. (2012b). *Using outcomes-based education as a strategy for improving the academic achievement of senior engineering students*. Paper presented at the INEEE 2012.

Swart, A. J., Schoeman, R. S., & De Jager, H. (2006). Advances in Computer, Information, and System Sciences, and Engineering. In K. Elleithy, T. Sobh, A. Mahmood, M. Iskander & M. Karim (Eds.), *Assessing senior engineering students with regard to radio communication principles* (pp. 413-417). Dordrecht: Springer.

Swart, A. J., & Sutherland, T. (2007). *Fusing theory and practical in a curriculum for engineering students - A case study*. Paper presented at the AFRICON 2007 international conference.

Tucker, A. (2012). Jack Andraka, the Teen Prodigy of Pancreatic Cancer. *Smithsonian.com*.

White, K. S. (2012). *Effective Poster Design*. Utah State University.

Zakaria, E., & Iksan, Z. (2007). Promoting Cooperative Learning in Science and Mathematics Education: A Malaysian Perspective. *Eurasia Journal of Mathematics, Science & Technology Education, 3*(1), 35-39.

Zvirbule-Berzina, A., & Gruzina, Z. (2011). *Development of MSMEs in the Regions of Latvia*. Paper presented at the Economic Science for Rural Development Conference Proceedings.

◈◇◈