2000

Tailoring IT Education for Effective IT Professionals in a Third World Setting

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Abstract

Small group learning combined with innovative teaching methods were introduced at tertiary level to teach computer-related subjects. Teams were constituted according to Belbin's theory of effective team building. A study conducted over two years showed that certain qualities needed in the IT field were lacking in these students.

1. Introduction

This research focuses on a different approach to tertiary teaching and learning in a Third World setting. It is a context in which the students are linguistically and culturally diverse and where the prior educational backgrounds and experience of students have not provided a sound foundation for undergraduate learning. These students spend on average more than the required number of years to complete their degrees (See *Figure 2*). Furthermore, a small percentage has had exposure to computers prior to university. (In a survey conducted in 1997 it was found that 41% of schools in South Africa did not have electricity [Bot, 1997].)

Teamwork was initially introduced at the University of the Western Cape (UWC), South Africa, as the "chalk-and-talk" method of teaching proved to be sub-optimal [Venter & Blignaut, 1998]. The 203 students who participated in the study were a combination of Computer Science (48.3%) and Statistics (51.7%) students. There is a perception that IT graduates from our university are not as marketable as we wish them to be because they lack some important skills. These are similar to skills that Denning [1993: 102] identified as lacking in today's computing curricula:

- *Actional knowledge* – required to be competent at designing and building applications
- *Systems thinking* – the capacity to interpret problems and designing computing systems that will assist people in solving these problems
- *Learning about the processes of invention and innovation* – in order to contribute to the "learning organisation"
- *Learning how to learn* – students will constantly face new challenges for which their current knowledge will be inadequate.

Teams were initially constituted to allow students in geographical proximity to work together even when not on campus. These teams, however, often disintegrated because members never gelled into a synergistic team. To remedy the above-mentioned shortcomings in team construction, subsequent teams were constituted with the aid of Belbin's team-role methodology [Belbin, 1993]. Belbin's validated and standardised questionnaires (a self-assessment as well as the minimum of four observers' assessment questionnaires) and the software Interplace IV, were used to determine each student's psychometric profile. These profiles were then used to constitute so-called "balanced teams" based on Belbin's team-role theory. In the current application of Belbin's method of team constitution, care is taken that students within groups are academically diverse (thus that there is a good mix of high achievers and low achievers in a team).

Belbin identified nine team roles, each of which has a distinctive contribution to make to successful team functioning. The nine team roles are: Plant, Resource Investigator, Coordinator, Shaper, Monitor Evaluator, Teamworker, Implementer, Completer Finisher and Specialist. Each person's profile consists of all these roles but in a ranked order - the three dominant team roles in a person's profile are the roles that are naturally assumed by the person.

The nine team roles can be grouped into four categories (See *Table 1*). Each team role has a set of strengths and weaknesses associated with it. Belbin maintains that optimal team functioning is only possible once team members delegate tasks related to their personal team-role weaknesses to other team members who have these skills as strengths. To constitute an effective team, Belbin argues that team members collectively should display the personality traits associated with all the team roles.

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Table 1. Belbin's team roles grouped into four categories

TEAM-ROLE CATEGORY	TEAM CONTRIBUTION	WEAKNESS
Ideas Roles	The **Plant and Resource Investigator** bring ideas to the team. The Plant tends to contribute self-generated ideas, while the Resource Investigator is a good scout and collects ideas externally to the team, thus avoiding an internal focus.	The associated allowable weakness of the **Plant** is forgetfulness and that of the **Resource Investigator** is a tendency to be easily bored and somewhat erratic.
Leadership Roles	The **Shaper** creates a sense of urgency in the team and focuses the team's activities on stated goals. The **Coordinator** who is like the conductor of an orchestra, co-ordinates the activities of the team inconspicuously to achieve mutually formulated goals.	The **Shaper** can be aggressive and provoke others and thus hurt people's feelings. The **Coordinator** can be manipulative and can be viewed as lazy.
Control Roles	The **Monitor Evaluator** is a very analytical individual and can evaluate alternative possible solutions without becoming emotionally involved. The **Completer Finisher** is conscious of detail, while the **Implementer** is a well-organised individual, able to prioritise tasks.	The **Monitor Evaluator** tends to be to be overcritical. The **Completer Finisher** can get bogged down in unnecessary detail and become anxious, while the **Implementer** can become rigid.
Support Roles	The **Teamworker** is the individual who offers emotional support and alleviates conflict in the team. The **Specialist** is the team member who provides "technical support" if the team's area of concern is within his/her area of personal interest.	The **Teamworker** can be indecisive and the **Specialist** territorial.

The small group learning approach proved to be successful and is currently the method of teaching in Computer Science and Statistics courses at UWC. (In 1997 a statistically significant improvement was found in the achievement of students when using the small group learning approach compared to the "chalk-and-talk" approach [Blignaut & Venter, 1998].) The majority of students experienced the implementation of small group learning positively.

The research approach that was followed in this study included both the positivist as well as the non-positivist perspective in order to view the problem holistically.

2. Method

Viewing the research from both the positivist and non-positivist perspectives gave the researchers the opportunity to reflect on the contribution the study could make to the body of knowledge currently available. The research methodology used in this study is typical of the grounded theory approach, where advantage was taken of emergent themes [Pandit, 1996]. According to Pandit grounded theory is not generated *a priori* and then tested; rather, it is "inductively derived".

Data is therefore collected, analysed and certain phenomena relevant to the research are allowed to emerge.

The non-positivist approach entailed the use of unstructured interviews (using Schön's Reflective Conversation protocol [Schön, 1983]), e-mails and field-notes.

The positivist approach entailed the use of self-administered questionnaires to collect data for the quantitative analyses. This was done at several points during this study. Data over a two-year period were collected to form a data set of 203 students. Although each student's team-role profile consists of all nine team roles in ranked order, only the three dominant team roles of each student's profile were used for analysis purposes. These were then grouped into four groupings (control, ideas, leadership and support).

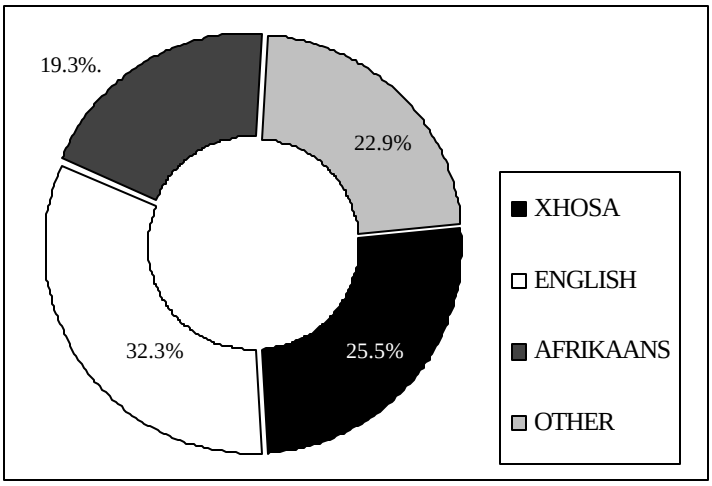

Figure 1. Home language of the combined group

3. Results

3.1 Background

To ensure independence in the data only one record per student was used. If a student repeated a course or enrolled for both Computer Science and Statistics, the record with the highest final mark was included.

Forty eight percent of this combined group was female and the majority was older than 21 (70.6%). Computer Science was still male dominated (58%) and Statistics attracted more females (53%). Two thirds were studying towards a B.Sc. degree (66.7%) and a third towards a B.Com degree. Their home languages were Xhosa (25.5%), English (32.3%), Afrikaans (19.3%) and other African languages such as Zulu, Ndebele. South Sotho etc. (22.9%) (See *Figure 1*). Only 42.3% accessed the Internet regularly and of these the majority were men (^{2} = 13.373, p = 0.001). A mere 23.9% used a computer at home.

The data of this study was collected during the 1997 and 1998 academic years, at the time the students were either in their second academic year (the Statistics group) or third academic year (the Computer Science group). It was thus expected that 27.1% of the students of the combined group would have registered in 1995, 40.4% in 1996 and 32.5% in 1997. However, it seems as if students spend more than the expected number of years to reach there second or third academic year (see *Figure 2)*.

3.2 Belbin team-role analysis

Belbin's research indicates that the overrepresentation or under-representation of team roles (imbalances) in teams causes predictable problems, unless the teams are made aware of these imbalances and taught appropriate coping strategies. Experience in the management development arena has confirmed these findings.

Our findings reveal that the team-role profiles of Statistics students (Control 25.7%, Ideas 29.5%, Leadership 21.9% and Support 22.9%) tend to be more homogeneous than those of the Computer Science students *(See Table 2*).

Even though the perception may be that students whose dominant roles are in the Ideas and Leadership role categories should be the high achievers, this was not found. For each of the role categories the average final mark achieved was *very* similar, therefore dominance

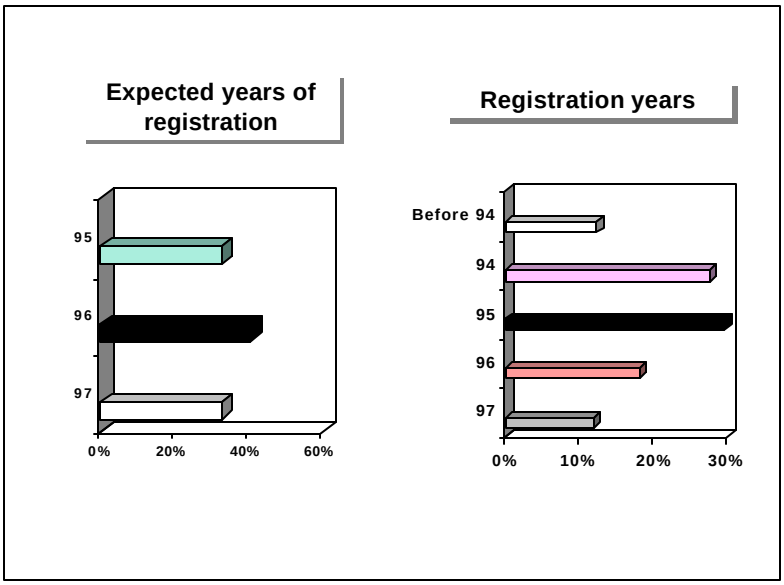

Figure 2. Year of registration

of role grouping had no bearing on achievement. Most students (78.1%) felt that they had gained insight into their strengths and weaknesses according to Belbin's team-role theory.

4. Discussion

Small group learning using Belbin's theory to constitute teams were successfully implemented in a Third World setting where students are linguistically and culturally diverse. At the same time limitations in the natural representation of certain team roles among students were identified. This will be addressed in future research.

The team-role profiles of the Computer Science group of students reveal a high representation of the Control roles and Ideas roles. This signals that they will be able to develop and implement ideas in a fairly well-organised fashion in a learning situation. However, the danger exists that new ideas will be implemented by "trial-and-error", because the Monitor Evaluator role makes for only 20% of the Control roles. The presence of the Completer Finisher role (20% of Control roles and 6.1% of all team roles) is low and, as a result, a lack of attention to detail may lead to omissions and unnecessary mistakes in the learning situation.

The Plant role (88% of the Ideas roles) was well represented and should lead to an abundance of self-generated ideas and alternatives to explore. However, the learning teams may find it difficult to identify the better ideas, because of the low representation of the Monitor Evaluator role. The teams may also be subjected to disruptive conflict. Experience indicates that the high incidence in teams of individuals who display a combination of Plant and Shaper team-role strengths and weaknesses leads to overly egocentric behaviour. The Resource Investigator accounts for only 12% of the Ideas roles (4.1% of all team roles), and this may cause an inward focus (lack of "investigative" interaction with other teams or their learning environment, thus "re-inventing the wheel"). The learning teams may experience a strong sense of urgency (the Shaper role accounts for 81% of the Leadership roles and 13.3% of all team roles), but this can lead to the suppression of valuable contribution

Table 2. Team-role results of the Computer Science group

ROLE CATEGORY	%	TEAM ROLE	%
Leadership	16.3	Shaper	81
		Coordinator	19
Control	30.6	Monitor Evaluator	20
		Implementer	60
		Completer Finisher	20
Ideas	33.7	Plant	88
		Resource Investigator	12
Support	19.4	Teamworker	69
		Specialist	31

from other less assertive team members. With low representation of the Coordinator role (12% of the Leadership roles and 3.10% of all the team roles) and the social roles (Resource Investigator, Teamworker and Coordinator) in this group, it is questionable if solutions to problems posed would be client-orientated. Investigative skills and ability to listen with insight need to be developed, as the natural representation of these skills in this group was low.

The students studying Statistics seem to be a more diverse group with a more balanced representation in all the role groupings. When considering each student's two most dominant team roles, it seems as if assertive leadership and implementation skills were well represented within the group, but that there was a shortage of coordinating and analytical skills. The lack of the analytical skill in these students is particularly worrying, as this skill is extremely important for a statistician.

However, it should be kept in mind that these statistics students are in their second academic year and hopefully another year of studying statistics will allow the analytical skill to developed by the time they graduate. Specific programmes will have to be introduced to address the shortages of these identified core skills in both Computer Science and Statistics courses. Students need to be made aware of the need to develop these skills that are deficient in their profiles.

4.1 Bibliography

1. Belbin, R.Meredith. *Team Roles at Work*. Butterworth-Heineman. Oxford, England. 1993.
2. Blignaut, R.J. & Venter, I.M. "'Chalk-and-Talk' versus cooperative learning. A comparative study". *Proceedings of the 15th IFIP World Congress*, edited by Gordon Davies. Vienna/Austria and Budapest/Hungary: 139-148. 1998.
3. Bot, M. "Schools Register of Needs: A Provincial Comparison of School Facilities". *Edusource Data News,* 17: 1-4. 1997.
4. Denning, P.J. Designing new principles to sustain research in our universities. *Communications of the ACM*, 36(7): 99-104. 1993.
5. Pandit, N.R. "The creation of theory: A Recent Application of the Grounded Theory Method". *The qualitative Report*, 2(4), http://www.nova.edu/ssss/QR/QR2-4/pandit.html. 1996.
6. Schön, D. A. *The Reflective Practitioner*. Basic Books, New York. 1983.
7. Venter, I.M. & Blignaut R.J. *Computer Science a team effort? Using Psychometric Profiles in Team Construction*. Technical Report, UWC/TRB/97-01. University of the Western Cape, Bellville. 1997.