

## Portfolios — a strategy for reform in information technology teaching

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Changing societal needs and philosophies of education constantly require academics to rethink teaching and learning. Currently, globalisation and the reconstruction of society have radically changed the profile of the student body. Assessment is without doubt one of the major 'drivers' of the teaching-learning process that steers the quality of learning. Research has established that portfolios can be used as a flexible and versatile tool to support student-centred learning, as well as assessment. Coupled with the fact, that the student's perception of the assessment procedure is the single most important influence on learning, this led to the introduction of portfolios as part of the teaching methodology for Information Technology (IT) students at the Vaal University of Technology (VUT) in 2000. In 2002 a research project was launched to determine the effect of the portfolio intervention. All the IT students enrolled in 2002 at the VUT were included in the research project. The outcome of the portfolio implementation project is reported on. The following three objectives were used as a basis for discussion and reflection: firstly, the description of the portfolio development process; secondly, an evaluation of the outcomes that include changes in knowledge and attitude that resulted from this project as well as the effect on the pass rate; and thirdly, impact objectives that focus on changes in the long-term performance of students that resulted from the research project.

**Keywords:** portfolios, lifelong learning, teaching strategy, constructivism

### Introduction

Skills are things we can do; strategies and tactics involve the conscious decisions to implement those skills and learning strategies are combinations of cognitive skills implemented when a situation is perceived as one demanding learning (Schmeck, 1988). Research has established that portfolios can be used as a flexible and versatile tool to support student-centred learning, as well as the assessment of learning (Snadden & Thomas, 1998; Baume, 2001; Estrem, 2004:126). Portfolios allow an educator to assess the entire scope of a student's work in a timely fashion and to analyse a student's progression in acquiring a variety of learning outcomes (Wright, Knight & Pomerleau, 1999:89; Gordon, 2003:336; Gibbs, 2004:27). But are portfolios as successful as they promise to be? In this article, the characteristics and impact of portfolios are examined from the students' point of view. In 2000, the IT department of the Vaal University of Technology, included portfolios in its teaching and learning strategy to direct assessment towards obtaining the ultimate learning outcome of higher education: to improve retention, foster lifelong learning, and to produce graduates with the appropriate knowledge and skills.

### Background

Changed societal needs and philosophies of education constantly require academics to rethink teaching and learning. Du Prè (2003:10) claims that globalisation and the reconstruction of society implies that South African institutions have to deal with under-prepared students. The development and availability of skilled manpower in the Information and Communication Technology (ICT) sector is gaining crucial importance in South Africa. In the National Plan for Higher Education (RSA, 2001) the South African Department of Education proposes that enrolment ratios over the next five to ten years should be changed from 49%, 26%, and 25% to 40%, 30%, and 30% for humanities, business, and commerce, and science, engineering, and technology, respectively.

The rapid advances in technology laid another challenge at the doors of universities of technology: they need to become key players in the practice of technology especially within teaching, transfer of knowledge, research and developmental activities. General universities are known for their wide range of disciplines offered through various programmes. Although technology is often used in the programme delivery or part of the curricula of a programme, technology is not always the main focus of study. At a university of technology, technology is the object of study.

The above technology challenges are recognised on macro-level by the Department of Education, as the White Paper on the Transformation of Higher Education (RSA, 1997) clearly states that higher

education must be restructured to meet the "needs of an increasingly technological economy with the capacity to participate in a rapidly changing global context" and "to prepare for integration into the competitive arena of international production and finance". The white paper clearly indicates a new "technology focus".

On a micro-level, educators should sharpen their instructional approach by continually asking themselves three questions:

- What are the essential skills and knowledge I am trying to teach?
- How can I find out whether students are learning them?
- How can I help students improve their learning?

Assessment is without a doubt one of the major 'drivers' of the teaching-learning process which will steer the answers to the above questions towards a particular learning outcome. When setting tasks at higher cognitive levels, the prompting of higher level cognitive functioning will not succeed if assessment is not aimed at demonstrating higher order tasks (Boughey, 2000:10; Troskie-de Bruin & Otto, 2004:322). While assessment has the potential to improve learning for all students, historically it has acted as a barrier rather than a bridge to educational opportunity, because assessment has been used to label students and put them in dead-end tracks (Porter, Youngs & Odden, 2001:7).

This article reports on the outcome of portfolios, as implemented in the subject Information Systems (first, second, and third-year level), by focusing on the following three objectives for discussion and reflection:

- How portfolios as an assessment tool can enhance learning. Students were required to complete a comprehensive portfolio, as opposed to a subject portfolio. They were advised to concentrate on their major subjects and the specific areas in which they preferred to specialise. A change in learning and assessment strategy is a highly structured activity and as such requires substantial levels of planning, development and implementation (Gordon, 2003:335). Therefore the researchers developed a detailed outline and have developed an implementation strategy that ensured the critical aspects of this process were covered by the students as they progressed through their activities. This outline corresponded to the various activities necessary to achieve the intended outcomes, such as the development process, assessment, feedback, and reflection.
- An evaluation of outcomes that focused on changes in knowledge and attitudes that resulted from this project.
- Impact objectives that focused on changes in the long-term performance of students that were expected to result from portfolio compilation.

## How portfolios as an assessment tool can enhance learning

Portfolio compilation and assessment require active learning, which can only occur when students invest physical and mental energy in activities that help them make meaningful what they are learning (Santrock, 1997:300). Although portfolios were initially viewed as an alternative assessment method, they have also become an academic development process for students. Consequently the underlying principles, on which the portfolio compilation process was based, are discussed. These include constructivism, whole-brain learning, and action learning.

### Constructivism

Learning, underpinned by constructivism will include learning experiences and activities that are: (1) constructive, (2) cumulative, (3) self-regulated, (4) goal-oriented, (5) situated, (6) collaborative, and (7) individually different (De Corte, 1996:147).

Constructivism has important implications for the use and assessment of student portfolios. If the aim were merely to monitor performance, then conventional testing would probably be adequate, but if the aim is to improve performance across the board, then assessment must be composed of exemplary tasks, criteria, and standards (Sanders & Horn, 1995:7). In particular, grading should be holistic: a portfolio should be evaluated as a whole, not in bits and pieces (Bryant & Timmins, 2002:2; Walker & Warhurst, 2000:37). Bloom's taxonomy was shared with students to explain the notion of a need for a broad base of knowledge and understanding (lower order of taxonomy) to be able to make a synthesis or an evaluation of knowledge (higher order of taxonomy). Table 1 summarises the principles of constructivism as applied during portfolio compilation (Sanders & Horn, 1995:7).

It is important to note that a portfolio, which is simply a container into which a large amount of unexplained evidence has been inserted, would not achieve its purpose or contribute to meaningful learning. The most significant part of the portfolio is its 'reflective heart' (Bryant & Timmins, 2002:3). Reflection forms part of the steps of action learning and is covered later.

**Table 1** Principles of constructivism applied during portfolio development

Principles of constructivism	Emphasis of portfolio assessment
Active, constructive knowledge environment	View of student
Integrated and cross-disciplinary	Scope of assessment
Portfolio is composed of exemplary tasks, criteria, and standards. Students must actively make sense of new knowledge and integrate it with previously held concepts and information	Beliefs about knowing
Specific attention to metacognition, motivation, self-determination and self-directed learning	Emphasis of instruction
Authentic assessment on contextualized problems. Emphasis on higher-level thinking, no single correct answer	Characteristics of assessment
Activities were assessed over time which formed part of the portfolio content	Frequency of assessment
High-tech applications such as administration and scoring sheets, computer-adaptive testing, and simulated environments	Use of technology
Multidimensional assessment so that student recognises the variety of human abilities and talents, malleability of student ability, and that IQ is not fixed	What is assessed?

### Whole-brain learning

Whole-brain teaching and learning also formed an integral part of the teaching strategy, since it allowed students to focus learning events according to their learning preferences and to incorporate learning styles to broaden their skills.

The whole-brain teaching and learning approach starts with several teaching and learning assumptions (Leonard, 2000:2):

- students have different preferred modes of thinking and learning;
- these preferences influence how they process, store, retrieve and make meaning out of information;
- learning groups are made up of students with different thinking style preferences, different ways of knowing and different learning styles;
- effective learning is "whole-brained", taking advantage of all the mental processes of the brain;
- educators and students typically design learning experiences that reflect their own thinking and learning preferences.

In the light of the above, we need to re-examine all our previous assumptions about teaching and learning. The content, design and delivery of modules should be whole-brained to meet the diverse learning and thinking styles of the students. Whole-brain application in portfolios is considered in Table 2.

For implementation of continuous assessment, the action learning cycle proved useful and relevant.

### Action learning

Action learning is a continuous process of learning and reflection, with the intention of getting things done. Through action learning individuals learn with and from each other by working on real problems and reflecting on their own experiences.

Hence, action learning involves learning from investigation, as part of a larger team, making decisions about necessary changes, applying these and evaluating the consequences. Zuber-Skerrit crystallised this concept by defining four major phases, planning, acting, observing, and reflecting, through which the 'action learning' cycle moves (Marquardt, 2004:28). The importance of group work and reflection, as part of action learning, is highlighted in the following two sections.

### Social context

The role of the social context of learning in shaping higher-order cognitive abilities and dispositions has also received much attention over the past years. It has been noted that real-life problems often require people to work together as a group in problem-solving situations, yet most traditional instruction and assessment have involved independent work, rather than small group work. Now, however, it is postulated that groups facilitate learning in several ways: modelling effective thinking strategies, scaffolding complicated performances, providing mutual constructive feedback, and valuing the elements of critical thought (Moust & Schmidt, 1995:288).

### Assessment

Portfolios were used as a formative and summative assessment tool for first-year students and only as a formative assessment tool for senior students.

Formative assessment was conducted over a wide range of subject-related projects and activities throughout each semester by letting students present their portfolios to peers and educators, and via self-assessment. Peer-assessment encourages students to be more reflective regarding their own work (Edwards & Sutton, 1992; Longhurst & Norton, 1997; Dochy, Segers & Sluijsmans, 1999). At pre-scheduled periods, students were requested to bring their portfolios to class for peer and educator review. During these sessions, outstanding aspects of individual portfolios were highlighted and shown to peers. The students were requested to assess their own portfolios, considering peer and educator comments.

For junior students, continuous assessment was implemented as a more flexible method of assessment than a formal written examina-

**Table 2** The quadrant model of the brain as discussed by Leonard (2000:2) according to preferences, frustrations, and possible portfolio implementation

Preference	Frustrations	Portfolio implementation
Theorists — logical, analytical, fact-based, qualitative		
To the point, factual learning like lectures with precise definitions; facts and details; critical thinking and reviews of textbooks and readings.	Vague, ambiguous instructions. Inefficient use of time.	Competency matrix, with an indicated competency level. Future plan of action regarding improvement of competencies. Provide evidence to support competencies. Use an expert to 'sign off' your work.
Organisers — organised, sequential, planned, detailed		
Learn through step-by-step instructions; outline work; checklists; exercises and problem solving with steps; policies and procedures; history and timelines and concrete examples.	Disorganised, poor sequencing, hopping around. Lack of practice time.	Organisation of portfolio — per module (distinguish between major and minor modules), alphabetically or in practical/ printout / documentation order. Create clear one- or two-word tab labels to make it easy to find specific documents. Personal details on each sample document, stiffy or CD.
Humanitarians — interpersonal, emotional, kinaesthetic, feeling-based		
Brainstorming; metaphors, illustrations and pictures; mind mapping and synthesis; holistic approaches; collaborative activities and the use of personal impact stories.	Impersonal approach or examples. No sensory input; sterile learning climate.	Reflective essay. Draw a mind-map of how topics in different subject modules interlink.
Innovators — holistic, intuitive, integrating, synthesizing		
Co-operative learning; group discussions; role-playing; dramatisation; brainstorming; mind maps; free association activities	Too slow a pace. Lack of overview/ conceptual framework.	Select a theme for your portfolio. Use coloured paper to draw attention to special work samples. Make use of visual representations like bar and pie charts. Develop a web site as an e-Portfolio.

**Table 3** Assessment rubric

Criteria	Component of assignment			
	Inadequate (49% – )	Emerging novice scholarship (50 – 64%)	Developing novice scholarship (65 – 74%)	Novice scholarship (75% +)
Presentation (title page, graphics, typing, length)	Unacceptable. Needs specific attention as indicated.	Technical requirements met.	Technical requirements exceptionally met, but with limited originality.	In accordance with standards with some added originality.
Technical care (page numbers, font, line spacing)	Some inconsistencies. Incorrect — not according to standards and specifications	Consistently accurate, cogent work. Neat.	Well presented and no inconsistencies.	Best critical and analytical work. Consistency in numbering and bulleting.
Reflective essay / Work philosophy	Confusing and conflicting issues. Inappropriate. Unclear.	Problems and issues stated and concluded.	Problems accurately summarised and stated.	Clearly understands, states and records key issues.
Theoretical discussion / literature study	Irrelevant and unnecessary literature consulted and assessed. Insignificant.	Reasonable and acceptable material assessed. Average.	Acceptable level and standard of literature consulted and assessed.	Most significant and relevant literature consulted, assessed, critically reviewed and integrated
Language, style and clarity of writing	Inappropriately casual and colloquial.	Shows basic mastery of writing.	Stimulating the reader. Exemplary use of language and style.	Captivating even the uninformed reader. A masterpiece of the genre.
Portfolio content	Limited proof of activities. Not clearly labelled.	Sufficient, but not professionally compiled.	Exceeds basic standard.	All skills are clearly reflected upon. Professional layout.

tion at the end of a semester. The portfolio contributed the biggest percentage of the final mark. A session was scheduled on the examination timetable and a name list was published indicating time-frames for interviews. The summative assessment was conducted in the form of a ten-minute interview with a team of educators. Students came to the interview with a completed self-assessment form, which allowed them to reflect on their portfolios. The rubric that was used for port-

folio assessment is illustrated in Table 3.

Multiple entries that supported each objective increased portfolio reliability and supplemental artefacts, such as audio or video pieces, were used by students to provide additional evidence of authenticity. No documentation was accepted unless a header, containing the student number and compilation date was included on the document. Although this precaution would not make it impossible to copy an-

other student's work, it surely complicated copying of work. The same authenticity principle was applied to software programs; on every screen the student number had to be indicated.

*Reflection*

Portfolios encourage students to reflect, after any major work, on what went well and what could have been improved. Bourner, Beaty, Lawson and O'Hara (1996:32) view action learning as a process of reflection and action, aimed at improving the effectiveness of action. The purpose is to learn from experience and to act more wisely. The process can be used wherever a group can support the learning of others in a context where experience can be reflected on. McGill and Beaty (2001:11) note the importance of reflection in the process in their description:

Action learning is a continuous process of learning and reflection, supported by colleagues, with an intention of getting things done. Through action learning individuals learn with and from each other by working on real problems and reflecting on their own experiences.

Traditional assessments, such as tests or many course projects, often do not allow for such reflection, as the educator grades the test or project using the established grading system, and the students move on to the next assignment. Posner (1993:20) held that we do not learn from experience as much as we learn from reflecting on experience.

Knowledge gained through reflection goes a long way toward ensuring improvement in future activities, especially where similar skills are required. Therefore, students' reflections about their own work and that of their peers should become a significant part of the portfolio compilation process. The portfolio is the only instrument that concurrently improves instruction through the process of reflective writing and self-scrutiny that evaluates performance within a framework of narration and evidence (Zubizarreta, 1994; Lippert, 2004:23).

**Outcome objectives**

Assessment interviews and questionnaires were used to obtain feedback from all students regarding changes in knowledge and attitudes that resulted from this project. Towards the end of the academic semester, junior and senior students were asked to complete a questionnaire that consisted of rated and open-ended questions. All IT students were included in the project, who numbered a total of 205 students. Not all the questionnaires were sufficiently completed and they could therefore not be used. A total of 175 questionnaires were eventually analysed. Based on the above figures, a feedback of 85% was received. From this total, 101 questionnaires were completed by senior students (from second year up to *Baccalaureus Technologiae*) and 74 by junior students.

The pass rate and throughput rate of first-year students were compared against previous years. For this comparison only first-year results were used, as this was the only instance where portfolios had been used as a summative event.

**Information system results**

In Table 4 the results of first year students are summarised over a time period of seven years. Results indicated a significant increase in the throughput rate since 2001 when portfolios were introduced. The entry requirements for this course remained unchanged over this period.

*Discussion of Questionnaire*

Each question posed to the students had three components, namely, a statement, the level of agreement, and the student's motivation for the level of agreement. This allowed for quantitative results as well as qualitative feedback.

Students responded by using the rating scale as indicated in Figure 1 and they could also state a reason for their answer. The following statements were presented to students:

1. The guidelines provided for the compilation of my portfolio is
2. The compilation of a competency matrix to include in my portfolio is

**Table 4** Results of students over a period of 7 years for Information Systems 1

Year	No. of students		Percentage of students		
	A Enrolled	B Admitted to exam	C Passed	D Pass rate	E Throughput rate
1996	110	97	53	55%	48%
1997	187	152	97	64%	52%
1998	144	120	80	67%	56%
1999	116	65	54	83%	47%
2000	134	113	74	65%	55%
2001	114	102	87	85%	76%
2002	145	140	94	67%	65%

3. Providing practical proof of skills for my portfolio is
4. Buying a folder for my portfolio is (finance)
5. The contents of my portfolio is
6. The time spent on my portfolio is
7. The effort to compile my portfolio is

Students needed to read the statement at each question and then decide whether the scenario described in the statement is

**A** a severe problem;

**B** a problem;

**C** a slight problem; or

**D** no problem for the student.

**Example of a typical question and how it should be answered**

Question	A	B	C	D
	... a severe problem	... a problem	... a slight problem	... not a problem
Compiling my portfolio is	✓ A	B	C	D
<i>Because I do not know what to list in my portfolio</i>				

Figure 1 Example of the questionnaire

The students' responses to the above statements are summarised in Figure 2.

Less than half the students (47%) found the guidelines sufficient. Students identified a number of obstacles as motivation for their response:

- requirements differ according to lecturers
- we had a lot to do within a short period of time
- I have never seen a professional portfolio
- [a portfolio] costs too much (5)
- I am not sure how to present my documents, in which order and how much info is needed
- I don't know how to organise a portfolio in a presentable way

These results could also be partly due to the fact that portfolios are only assessed and promoted in the Information System module. For the same reason less than half of the students (46%) found it easy to gather enough contents to include in the portfolio.

Figure 2 indicates that 65% of the students did not experience any problems with the compilation of a competency matrix. The most probable reason is that much time is spent on the process in class and the fact that the IT course includes a lot of practical skills to be listed in a competency matrix. Feedback can be summarised in the following response:

*"I feel it is important for me to present myself well in terms of my capabilities and skills."*

Although students came from low-income families and had limited financial support, the majority did not perceive it as unnecessary to spend money on buying a portfolio folder (54%).

A high percentage of students had no problem including practical

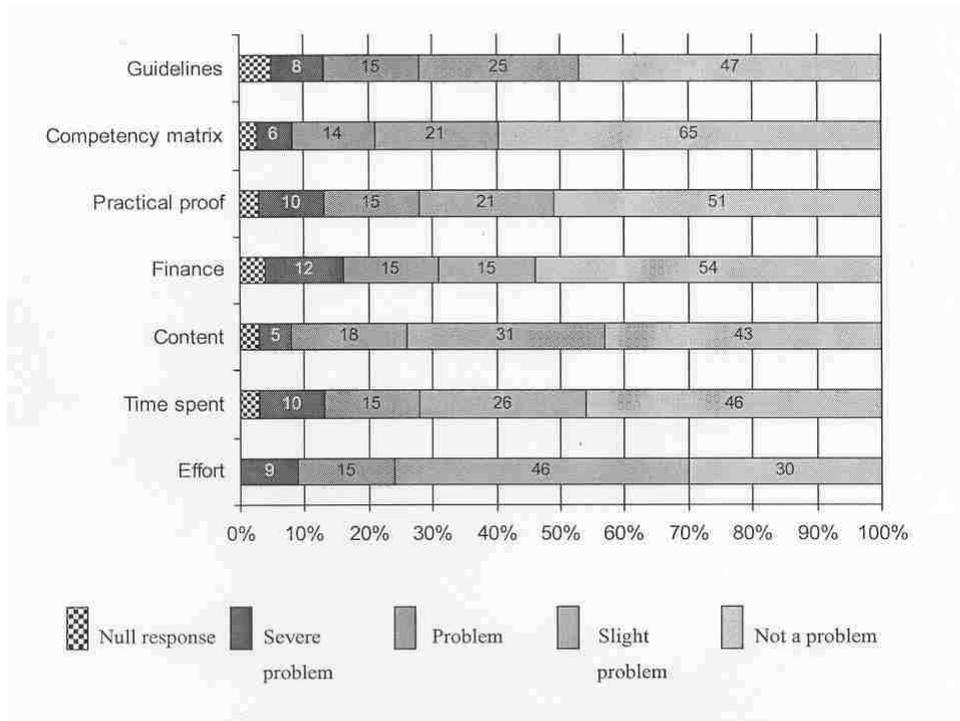


Figure 2 Response from students regarding portfolio compilation

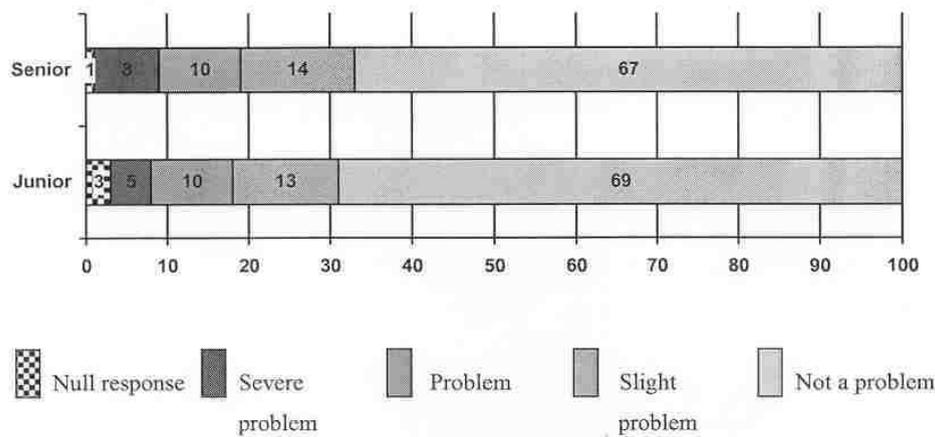


Figure 3 Students' indication of whether they would continue updating their portfolios after leaving the institution

proof of skills in their portfolios (51%). However, some students experienced problems, related to the compilation and finding of appropriate proof of competencies:

- *in the first year I don't have enough material/resources*
- *[a portfolio] needs printing and typing to look presentable and professional (time becomes a problem)*
- *I can't find some of my practical projects*
- *I don't know whether to include disks or printouts*

Figure 2 revealed the following regarding the portfolio development process:

- Guidelines (53%), content (57%), time spent (54%) and effort (70%) were perceived as problematic (noted as "severe problem", "problem" and "slight problem") by the majority of students, most probably because portfolio compilation is a continuous process and new information must constantly be added to it.
- Only a small percentage of problems experienced were considered as being severe. The statement that received the highest score for being a severe problem was finance (12%).

- The compilation of a competency matrix was the most positive as 65% of the students did not experience any problems with this activity.

The fact that only a small percentage of the students experienced severe problems is a positive indication that the action learning cycle was mutually beneficial for the group and for the individual students.

**Impact objectives**

The questionnaire (see Figure 1) allowed the students to provide reasons for their answers in the form of an open-ended response. Similar responses were categorized and numbers in brackets indicate the number of students with similar comments. Responses from students, as summarised in Table 5, indicated that portfolios supported the development and integrated assessment of critical cross-field outcomes (CCFO).

The last question on the questionnaire provided students with the opportunity of indicating whether they envisaged keeping on updating their portfolios after graduation. The responses are shown in Figure 3.

**Table 5** Comments from students reflecting on critical cross-field outcomes

C C F O	Responses from students as perceived from unedited comments
Identify and solve problems	<i>sometimes I struggle with getting info on Internet (7)</i>
Work effectively with others	<i>we are doing things in a group (13)</i>
Organise and manage oneself	<i>[a portfolio] will help organise my stuff(8)</i> <i>[a portfolio] it is my responsibility (11)</i> <i>[a portfolio] is not much effort and it helps me to put my things in order(3)</i>
Collect, analyse, organise and critically evaluate information	<i>it gives me a chance to group all the relevant documents in one accessible place (19)</i> <i>I am not sure how to present my documents, in which order and how much info is needed (2)</i> <i>I do not know what to include (28)</i>
Communicate effectively	<i>I feel it is important for me to present myself well in terms of my capabilities and skills (5)</i> <i>a [portfolio] gives me time to present the skills which I have acquired (7)</i>
Use science and technology effectively and critically	<i>I can see my abilities in different environments (8)</i> <i>a [portfolios] show all the skills that I have (12)</i> <i>compile and present a PowerPoint presentation (2)</i> <i>all IT activities were meaningful (10)</i>
Demonstrate an understanding of the world	<i>portfolios are relevant for job hunting. It will make me look more professional (11)</i> <i>a [portfolios] is part of marketing for a job (5)</i>
Reflect on, and explore a variety of strategies to learn	<i>portfolios outline different areas of skills based on the different learning areas (3)</i> <i>I can see my abilities in different environments (13)</i> <i>I don't know how to document information (12)</i> <i>it motivates participation in additional activities (10)</i>
Participate as responsible citizens	<i>[a portfolio] would be useful when going for an interview (13)</i> <i>[portfolios] will just add to my experience and it will help me (4)</i> <i>even in job interviews portfolios act as a marketing tool (3)</i>
Be culturally and aesthetically sensitive	<i>I can put all that I do in the portfolio (11)</i>
Explore education and career opportunities	<i>[portfolios] will help me in my future life (17)</i> <i>I will need to use my portfolio in the future (18)</i>
Develop entrepreneurial opportunities	<i>[portfolios] motivate participation in additional activities (20)</i>

## Conclusion

The aim of using portfolios was to empower students by enabling them to organise and monitor their own learning and to develop explicit consciousness of their strengths, weaknesses and preferences.

From the feedback and comments, it was evident that students perceived portfolios as a valuable tool to enhance lifelong learning and the management of their careers. They agreed that a portfolio should be compiled and positively contributed to their progress.

Based on problems that were found with the portfolio compilation and assessment process, some suggestions are made for the future application of portfolios in an IT environment.

To address the problem of insufficient guidelines during portfolio development:

- assessment guidelines should be made available via the learning guides;
- there should be a clear mapping of learning outcomes and assessment criteria; and
- exemplars should be provided of student performance, a poor assignment, a good assignment, etc. and they should be discussed with the students to define clearly the expected outcomes of portfolios.

The authors are of the opinion that the statements evaluated by the questionnaire and summarised in Figure 3 are interrelated and that, for example, by providing better guidelines, the effort made and the selection of content may also improve.

During assessment and obtaining of outcome objectives educators should:

- Focus on subject-specific as opposed to comprehensive portfolios. This will provide better guidelines, more focused content, and help them to direct their efforts.
- Combine an interview and a portfolio for summative assessment purposes, as it proves to be more successful than merely considering the portfolio.
- Compile a rubric with the evaluation criteria for the portfolios available at the start of each semester to be included in the learning guide, to serve as a benchmark for self-assessment, prior to formal assessment.
- Make students more aware of the fact that they are preparing themselves for a future career in IT. This may assist students in selecting exemplars of practical activities and also contribute towards career orientation. To achieve this, senior students could get involved in projects such as
  - in-service training projects where groups of students identify a business in their community that is still using a manual system and plan, design, and implement a comprehensive and streamlined computerised system addressing all business needs;
  - service learning projects where groups of students identify a school or group of adults in their community with no knowledge and access to computers, obtain a secure venue, populate it with second-hand computers and a simple net-

work and train these pupils and/or adults in basic computer skills;

- in the case of junior students, presentations by career specialists and visits to major companies could have a positive impact.

#### To reach the intended impact objectives:

It is important to integrate portfolios into the teaching and learning process and to constantly reinforce the application of action learning. Observation and reflection are critical for active learning as well as for collaboration with peers and lifelong learning.

By supporting the further development of student-centred exemplars, higher education institutions can constitute positive changes in the long term performance of IT students. There can be little doubt that, for a diverse student population, the future lies in developing and applying assessment methods that are underpinned by a strong and proven student-centred andragogical methodology like portfolio compilation and assessment.

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