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Student-Centred Assessments and their Impact on Learning – An IS Case Study

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Abstract
In higher education, one can find many different assessment methods ranging from the most traditional examination based assessment to computer-based on-line assessment and many other innovative assessment practices. Yet, achieving a high level of positive impact of assessment on student learning is always a major concern among academic practitioners. Choosing the right set of assessment modes, designing the assessment activities and evaluating their impact on student learning are some of the major challenges. This challenge is more pronounced in the recently emerging Information Systems (IS) programmes as there is an ever-growing wide variety of assessment methods matching with the ever-changing tools and techniques that evolve in the computer hardware and software disciplines. In such a dynamic context, IS courses in higher education are faced with a very short life-cycle and hence do not have the luxury of experimenting different assessment modes from time to time. They need to arrive at the right combination of assessments based on the prevailing situation. It is therefore a question as to which assessment methods are the best to be adopted and what is the impact of such assessments on student learning. This paper proposes a pragmatic four-step student-centred approach to identify and design suitable assessment methods and to examine their impact on student learning. The student-centred approach is illustrated through a study conducted for a particular IS course in a higher education setting. Due to the generic nature of this approach, it could be adopted in courses from other areas as well.

Keywords: Higher education, Assessment modes, Student learning, IS skills

Introduction

Over the past few decades, considerable emphasis has been laid in introducing continuous assessment methods as a mechanism to enhance student learning as against traditional exam-based assessments (Laurillard 2002). This has resulted in an evolution of a wide range of innovative assessment practices and strategies (Deeks 1995). This evolution is more prominent in Information Systems (IS) courses offered in higher education due to the ever-changing tools and techniques adopted in computer hardware and software contexts (Denning 2001). Due to the dynamic nature of IS and because it is a relatively new discipline (Gorgone 2002), it has become a challenge to design assessment methods that relate to student learning outcomes. IS courses in higher education try to adopt different assessment methods to evaluate the level of IS skills attained by the students (Little & Margetson 1989; O'Neill, *et al*. 1994; Oudshoorn, *et al*. 1996; Lejk, *et al*. 1997). Although these studies have shown that such assessment methods have aided in student learning, more recently there have been criticisms indicating failure to recognise the shift in student expectations (Ng & Ng 1997; Carter & Boyle 2002; Hill 2002; O'Neil, *et al*. 2003).

Student learning is predominantly determined by the assessment and not by the teaching or the curriculum (Biggs 1999). Hence, student learning and assessment always go hand in hand and the success of such an inter-relationship depends on various factors. Some of the contributing factors are, the nature of the course, the resources available, the student background / learning preferences and the artifacts used to mediate our activities (Vygotsky

1978). Giving due consideration to such factors, this paper describes a case study conducted on certain assessment practices adopted in an IS course and their impact on student learning. A four-step student-centered approach was developed as given below:

1. *Understand the student perspectives of learning*. This is achieved through a student survey administered prior to the commencement of the course and its analysis provides insight into the students' learning styles and their learning expectations.
2. *Identify the assessment modes suitable for the course*. This step focuses on identifying the assessment modes ideal for the course since a standard preformatted assessment structure would be sub-optimal. Hence, a few assessment modes for the course are carefully identified from literature, past practices and the present learning contexts.
3. *Design a set of assessments.* The key objective of the assessment design (based on the outcomes of steps 1 and 2) is to address the student learning needs as much as to serve as an instrument to evaluate the student understanding of the concepts and the skills attained through the course.
4. *Determine the impact of the assessments on student learning*. This is accomplished by analysing the students' responses to a follow-up survey administered at the end of the course. Apart from establishing the learning impacts, the survey would provide valuable insights for improving the assessment process.

In this pilot study, a group of forty students undergoing IS courses in a higher education setting was considered. Based on the above four steps, student perspectives of learning were studied first and these inputs were used to design three different assessment modes for a particular computer programming course undertaken by these forty students. This IS course had a past record of being a major hurdle for the students and hence, a survey was conducted and analysed to study the impact of assessments on student learning in this new approach.

Understanding Student Perspectives of Learning - Step 1

There is a general consensus in literature that students from higher education exhibit a number of different approaches to learning (Knowles 1975; Atkins 1995; Kolb *et al.* 1995). In general, there are two main levels of processing that takes place in learning (Marton & Saljo 1976):

a) surface-level processing, where the student has a 'reproductive' conception of learning which means that the student is adopting a rote-learning strategy and
b) deep-level processing, where the student is directed towards intentional content of the learning material or comprehending the principle, facts or problem situation given in the learning material.

Surface-level processing does not help in applying knowledge for real world situations, especially in the IS industry. In this context, we have conducted a survey among a group of forty students (hereafter referred as IS students), from an IS course (a computer programming course) offered in an undergraduate programme. They were asked to describe what they mean by 'Learning'. The students' responses fall under the following categories:

a) Learning means 'acquiring knowledge' in areas of interest
b) Learning is to 'gain knowledge for problem solving'
c) Learning means 'getting new experiences useful for future career'
d) Learning aids in 'understanding the topics and apply it in different situations'

While the categories a) and b) pertain more to surface level learning approaches, categories c) and d) seem to be more towards deep approaches to learning. It is observed that nearly 75% of the students have their responses under a) and b) collectively, while 15% responses fall under c) and the remaining 10% fall under d) category. Further, a majority of the students falling under a) and b) category reflect their learning towards situations like exams, tests, assignments and projects that form their assessment modes. Memorising for assessments was the commonest approach exhibited by computer engineering students (Ng & Ng 1997; Boud 1995). Only a few students under c) and d) categories correlate learning with a concern towards attaining skills as well as knowledge, with a deep learning approach that looks beyond graduation and towards a wider career and social setting.
Further, by analysing the profiles of these students, it was observed that these students coming to a higher education institution have previous learning patterns that they had cherished for many years during their primary and secondary schooling. Hence, students have prior experiences in learning and this has to be understood first. By understanding the IS students' perspectives of learning we were able to design the assessments suitably for a particular IS course under study.

While understanding the students' perceptions of learning, it is also important to consider the lecturers' perceptions of assessment in aiding student learning as they could have different intensions (MacLellan 2001). Though traditionally, the role of IS lecturers was considered as 'imparting knowledge' to the students, it is now getting transformed to the role of a facilitator in the students' learning process. Hence, in this study, the IS lecturers' perceptions were also gathered to design suitable modes of assessments for the IS course.

Identifying Assessment Practices in Higher Education - Step 2

Literature survey indicates that many researches have defined assessment with a view to give a summarised or diagnostic report on student learning (Brown and Knight 1994). Traditionally, tests and examinations were the most dominating means of assessment and marks or grades were the possible outcomes. Nowadays, there is a paradigm shift in the meaning attached to assessment in higher education. It can be thought of occurring whenever a lecturer interacts with a student to find out about the student's abilities. In this context, we have defined assessment with a student-centred approach as follows:

Assessment is a means of ascertaining the* strengths and weaknesses *of students and in guiding them through their learning process.

3.1 Main Categories of Assessment

Assessment methods are broadly classified under two main categories: formative and summative assessments (Brown and Knight 1994). Though it might be possible to provide separate assessment tasks for formative and summative purposes, it is more fruitful for an evaluation system to consider both aspects together, at all times (Murray 1994). Such an approach was adopted in designing the assessment tasks for an IS course in this case study.

Common Assessment Practices Adopted in IS Courses

In the field of IS, one is expected to have individual technical skills as well as team skills to work in IS group projects in real-life industry situations. From literature and practices adopted by various IS courses in higher education, it is observed that most of the assessment mechanisms in IS courses fall under the following three main categories:

Individual Assessment. Apart from traditional assessment methods such as written examinations, in an IS project environment, journals or activity logs and portfolio maintained by students are used to assess their learning processes. Other methods such as interviews, presentations and on-the-spot tests like assembling hardware parts, on-line programming with a computer are currently being more featured in IS courses (Garcia *et al*. 2005). However, though such computer technologies were initially seen as a powerful change agent in the learning process, students could easily be caught up with the task syntax rather than the task semantics (Taylor, Sumner & Law, 1997).

Group Assessment. Group assessment and group work help students to gain the necessary skill sets typically required in IS industry (Lejk *et al.* 1997). However, the problems with assessing groups where marks generally have a greater impact on the degree classification mitigate the use of group assessment in some universities (O'Neil *et al*. 2003). There is also scope for uneven contribution from different students in a group. Hence, sufficient emphasis for individual component of the group work is required to recognise the efforts put in by each student.

Peer and Self-Assessment. Both peer and self-assessment are aimed to help students to take responsibility for their work and to develop professional judgement and responsibility. In self-assessment, students are normally expected to submit self-appraisal reports or logs. However, self-assessment is rarely used in the determination of grades and greater reliability in assessment is found by having more than one assessor (Toohey *et al*. 1996). In peer assessments, students tend to evaluate from an external perspective, the quality of the other student's inquiry as a whole, without engaging in dialogue with the ideas articulated (Paavola *et al*. 2004). However, in IS courses, peer assessment is considered as a valuable exercise in self-development and preparation for their future careers in IS industry.

Designing the Assessments for the Case Study - Step 3

Assessments can have both positive and negative impact on student learning (Kniveton 1996). On one hand, some assessment methods induce students to adopt rote learning and hence the knowledge acquired will meet only the immediate examination pressures and would be quickly forgotten. On the other hand, some assessment methods are so designed that they provide the necessary opportunities for the students to apply their knowledge in solving real-life problems, stretching their understanding in correlating and integrating the concepts, with deep learning approaches (Hargreaves 1997).

According to Drew (1998), the degree of impact of assessment on student learning depends on what is the degree of attainment of certain transferable skills in each student. Some of the IS-related desired transferable skills are problem-solving skills, practical skills, critical thinking skills, inter-personal skills and time management skills. The reliability and validity of assessment could be enforced to a certain extent by having a variety of assessment methods, as students may not be able to demonstrate their knowledge and skills based on just one mode of assessment (Ashkroft & Palacio 1996).

Considering the desired transferable skills for IS along with the survey results obtained from Step 1 and Step 2, a matrix of assessment perspectives was developed in this study (Figure 1). Based on this matrix, three different assessments were designed for the IS course. The three assessments adopted were,

- an individual written test (on theory and practical concepts),
- an individual lab test (computer-based short practical test) and
- a group mini-project (IS solution for a case scenario).

Assessment Modes	*Lecturer Perspectives*	*Student Perspectives*
Individual Assessment (e.g. Written Test, Assignment, Research Write-up and Lab Test)	Thinking Skills Task Management Skills Practical Skills	Study Skills Problem Solving Skills
Group Assessment (e.g. Group Project and Group Assignment)	Time management Skills Task Management Skills Practical Skills Problem-Solving Skills	Practical Skills
Peer Assessment (e.g. Group Project) and Self Assessment (e.g. Assignment, and Exam)	Inter-Personal Skills Communication Skills Self-Organisation Skills Thinking Skills	Inter-Personal Skills Self-Organisation Skills

Figure 1: A Matrix of Assessment Perspectives

Designing an individual written test. From the feedback obtained about the learning styles of these forty IS students (Step 1), individual assessments were given importance and a mid-term written test (closed-book type) was designed so that the IS students get an opportunity to perform content analysis. Some short-answer type questions mainly based on a critical analysis of a case situation were designed for this purpose. The written test was designed to serve as a checkpoint for students to get a feedback on their strengths and weaknesses with respect to the topics covered until the mid-term of the IS course. This is in line with the progressive inquiry model (Stiggins 1994; Chi 1997). In addition, the advantage of this mode of assessment is that there is little evidence of cheating on such examinations.

Designing an individual lab test. According to the IS lecturers' viewpoint, individual IS practical skills in the discipline are exhibited through lab tests. Since the IS course under study teaches hands-on problem solving techniques using computer programming, a lab test was considered to be a good simulation of a real-life situation so as to prepare the students for the world of work (Teh & Fraser 1994; Oudshoorn, *et al.* 1996, Tynjala 1998). The lab test was an on-the-spot programming exercise, designed to evaluate the students' practical and problem-solving skills using a computer software tool.

Designing a group mini-project. Group work offers a platform for students in generating multiple perspectives, constructing shared meanings, reforming ideas and having interactions collaboratively that support reflection and development of transferable skills (Vygotsky 1978; Little & Margetson 1989; O'Neill & Gomez 1994; Brandon & Hollingshead 1999). Hence, a group mini project was chosen to provide a distributed expertise environment. In order to promote individual commitment, the group effort was given only 30% weight while the individual assessment component was given 70% weight, with explicit details of the assessment criteria for each component. There were scheduled weekly meetings for the students to discuss their work with their lecturer (project supervisor). A peer assessment form with lucid assessment criteria and evaluation guidelines was also designed for the mini-project.

Determining the Impact of Assessment on Student Learning - Step 4

A set of forty IS students who were involved in Step 2 of this study underwent the IS course, completing the three different assessments designed in Step 3, namely lab test, written test and mini-project. In Step 4, the impact of these three assessment modes on student learning was studied by conducting a survey with these students at the end of the course. As part of this survey, we designed a questionnaire (Appendix 1) that addressed the impact of these three

assessments on student learning. The questionnaire contained 14 questions (Q1 – Q14) with five options (ratings) from 1 to 5. Responses indicating 4 and 5 were attributing towards positive impact, a response of 3 indicates neutral impact and responses of 1 and 2 indicate negative impact.

Analysis Methodology

Based on the definition of assessment given earlier, the questionnaire (Appendix 1) was designed to evaluate how the *strengths and weaknesses* of students in the IS course were determined through assessments. Four criteria were identified for this purpose as listed below and the questions were framed to address these criteria:

a) the *importance of feedback* on assessments for student learning (Q1 and Q2),
b) the *level of deep learning* achieved through the three assessment modes (Q5, Q8, Q13 and Q14),
c) the *transferable skills* attained (Q3, Q4, Q6 and Q7) and
d) the extent of *self-directed learning* facilitated through assessments (Q9 – Q12).

The data collected from the student survey were analysed based on these four criteria. For each of the criteria, we assumed that all the questions addressing the criteria were of equal importance. It is possible to give a different weight of importance for each question based on the context and as perceived by the teaching team members (Venkatraman 2000). A normalised result of the impact of assessment for each of the four criteria was synthesised based on a set of normalized steps given below:

a) For each question, the positive, negative and neutral impact was calculated for each assessment mode. This could be done from Appendix 2 by aggregating the student responses (R_i): For example, ratings of 4 and 5 are considered as positive impact while 1 and 2 indicate negative impact and 3 considered to be neutral.

b) Multiplying each value obtained from a) above with the weight of importance (W_i) for each question resulted in normalised impact values ($R_i \times W_i$).

c) The average of the normalised impact values obtained from b) above was calculated by considering all the questions (say n questions) that contribute towards each of the four criteria. This provided an estimate of the overall percentage of impact associated with each assessment mode ($\Sigma (R_i \times W_i) / n$).

Trends in the Impact of Assessments

On analysing the survey results (Appendix 2) the impact of assessments are summarised below:

a) *Importance of feedback:* Figure 2 provides a comparison of the impact of the three modes of assessments on student learning based on the level of feedback provided on student performance (Q1 and Q2).
Based on the results from Q2, students perceive feedback from the lecturers to be important in all the three assessment modes (about 90% positive impact with very minor variations among the three modes). However, low response of 56% for mini-project indicates that the students expect more feedback from the lecturers regarding their *strengths and weaknesses* as they progressed in their project work. The meaningful feedback through lab test and written test (about 82% impact) had helped the students to correct their misconceptions and their mistakes committed. This was also evident from

their much-improved performance in their final examination that was conducted subsequently.

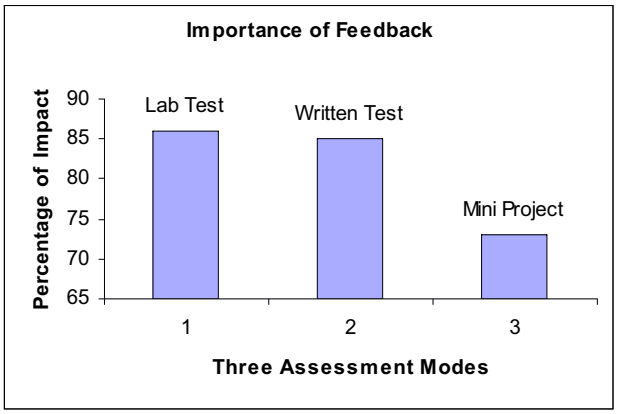

Figure 2: Comparison of the assessment modes based on feedback provided

b) *Level of deep learning:* The level of deep learning achieved by the students (Q5, Q8, Q13 and Q14) was compared among the three modes of assessments and their impact on student learning is shown in Figure 3. There is a high level of conformance from the results of Q5, Q13 and Q14 with about 90% positive impact for mini-project. This indicates that mini-project has facilitated the students to adopt a deep learning approach. However, lab test (about 55%) and the written test (about 20%) aid in surface level processing (rote learning). On the other hand, from the results of Q8, correlating concepts with other courses of their area of study was poorly rated (mini project with 64% impact, lab test with 44% impact and written test as low as18% impact).

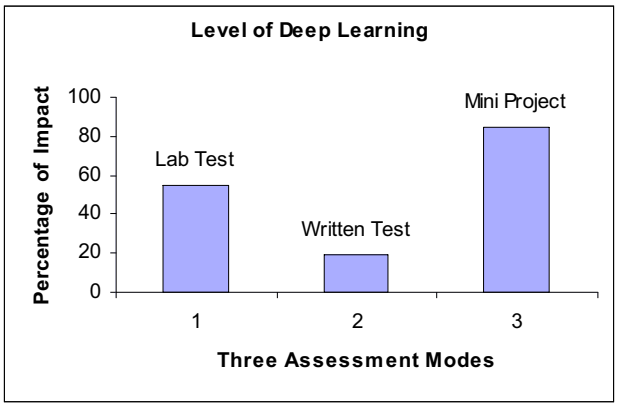

Figure 3: Comparison of the assessment modes based on deep learning achieved

c) *Transferable skills*: Figure 4 provides a comparison of the impact of the three modes of assessments based on the transferable skills attained by the students (Q3, Q4, Q6 and Q7). The group mini-project has aided to a great extent towards attaining technical skills (92% impact – Q3), applying creative thinking skills (84% impact – Q4), learning from peers (90% impact – Q6) and in achieving competitive learning skills (84% impact – Q7). The lab test and mini-project have helped in promoting competitiveness (Q7) amongst students (about 84% impact) when compared to written test (60% impact) due to the nature of the IS course.

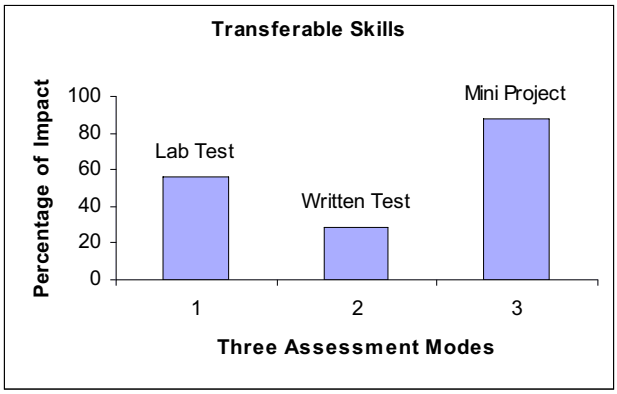

Figure 4: Comparison of the assessment modes based on transferable skills attained

d) *Self-directed learning:* Survey results from Q9, Q10, Q11 and Q12 indicate that all the three modes of assessment have provided sufficient opportunity for self-directed learning (Figure 5). The students felt that individual-based assessment methods such as lab test (about 84% impact) and written test (88% impact) helped them in self-directed learning as compared to the mini-project (74% impact).

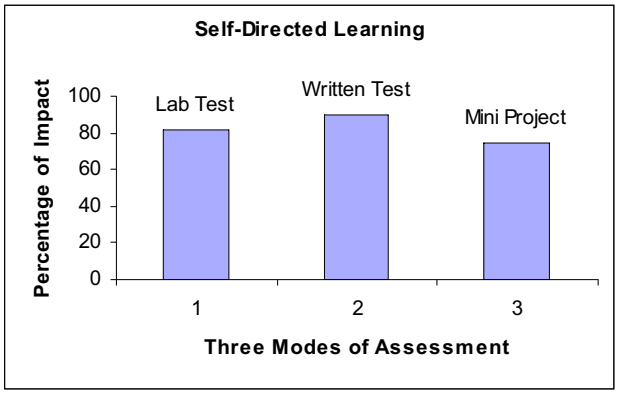

Figure 5: Comparison of the assessment modes based on self-directed learning

6. Discussion and Conclusion

The impact of assessment on student learning is definitely a multifaceted phenomenon. The type of assessment used, the process adopted and its reliability dictate the degree of achievement in enhancing student learning. The main thrust should be in matching the right set of assessment practices with the transferable skills under consideration. To achieve this, we provided a practical four-step student-centred approach that helped the lecturers to design suitable assessments for an IS course and its impact on student learning was determined.

Summary of Assessment Implications

Subsequent to the analysis of the survey results performed in Step 4, the lecturer observations as well as informal feedback from students collected throughout the course were considered to serve as counter checks aiding in the validity of the survey results. From these, certain

conformal implications of assessment on student learning were arrived at and these are presented below:

a) The students considered the lab test as the most preferred assessment mode in providing the necessary feedback for understanding their strengths and weaknesses of the IS course. This could be contrary to some of the less positive experiences reported in literature about computer-based assessments (Catterall & Iboston 1995; Brosnan 1999). However, the IS students did not show much anxiety in using computer to perform an assessment. This is attributed to the fact that similar practice exercises demonstrated during their weekly lab-based workshops aided in the familiarity of such a lab test.
b) Through the mini-project, the IS students were able to exhibit deep-learning attributes while they considered written test aiding in surface-level learning. This suggests that a traditional closed-book written test, though has the processing efficiency and reliability, does not promote deep learning.
c) While working on such an integrated project as a team, the group dynamics have helped the students to learn from each other's mistakes and accomplishments. Such collaborative forms of summative assessments motivate the students to gain the necessary transferable skills as they feel ownership of their assessment work. However, the survey in Step 4 indicates that students look for a better feedback mechanism in their project work.
d) From the lecturer feedback and student interview, it was observed that the peer assessment component in the mini-project was quite effective. Similar to the observations of Bridley & Soffield (1998) and Chandler & Hand (1995), initially, the IS students were not comfortable with peer assessment as they doubted it could lead to biased scores. However, once appropriate briefing and guidance were given, the IS students were critical and fair to the process of peer assessment as their evaluation scores compared very well with those given by the lecturers.
e) It was observed that all the three assessment modes did not provide much help to the students in linking and integrating the concepts with other related courses they were undergoing. From the informal feedback collected from the IS lecturers and students, it was recommended that students would be able to correlate the concepts with other courses if there is a common assignment or project for a few inter-related courses.

Suggestions for Assessment Improvements

The main recommendations made for the three assessment modes in order to enhance student learning are given below:

a) Formal lecturer *feedback* to be introduced in mini-project – The IS lecturers, as supervisors, had weekly meetings with each group of students involved in the mini-project. But, from the survey and informal discussions with students, this was not deemed to be providing sufficient feedback on their progress in the project work. A fortnightly formal feedback from lecturers that reveals clearly (in black and white), the *strengths and weaknesses* of each student, giving suggestions for improvements on their project work is recommended.
b) Case scenario based written test and lab test for promoting deep learning and *partnerships in curriculum* - The written test given to the students mainly assessed their understanding of theoretical concepts, aiding in mostly rote learning. On the other hand, the lab test assessed the practical programming skills for solving simple problems. In order to promote deep learning, these two assessments could be designed based on a case scenario discussed in the classroom environment. The case scenario could be even a common industry situation discussed in two or more related courses (say a Systems design course and a Programming course). This approach would facilitate deep learning as it would

encourage students to explore further about the theoretical and practical aspects of the case situation and would help in integrating the concepts taught in those related courses.

c) Redesign the written test to *assess specific transferable skills* – Some of the IS skills could be assessed in a written test by reformulating the questions to simulate different IS roles. For example, students could be assessed on the role of a software tester by asking them to write a set of test cases for a given computer program.

d) Fortnightly journal for a *self-directed assessment* process in mini-project – Normally students work in groups on a mini-project. By maintaining fortnightly journals, students would be able to self-assess and review their own learning and progress. This would complement the existing peer assessment component and the formal lecturer feedback (suggested above) for their mini-projects. In view of the additional self-assessment component, it is recommended to raise the ratio of individual and group assessment weights for the mini-project from 70:30 to 80:20 ratio.

Concluding Remarks

This paper provides a practical four-step student-centred approach to design assessments for a course and illustrates it with the aid of a case study in which a group of forty students from an IS course participated. The outcome of the case study reveals that the three assessment modes made varying degrees of impact on their learning, as each assessment mode addressed different learning dimensions. In conclusion, this study reveals the following:

1. A 20% increase in the average performance of these IS students and low failure rates as compared to the past imply that a multi-strategy approach that combines different assessment methods has clearly enhanced student learning in the IS course of study. It has resulted in about 85% positive impact through individual assessments such as written test and lab test with regard to promoting self-directed learning and about 90% impact through group and peer assessment such as mini-project with regard to promoting deep learning.
2. Every assessment should be designed to determine the strengths and weaknesses of student learning by incorporating the four criteria that were identified in the study, namely, (i) ability to provide feedback to the students, (ii) stimulate deep learning, (iii) capability to impart transferable skills and (iv) facilitate self-directed learning. The student survey reveals that no single mode of assessment prevails over the other modes in all these four aspects. This reaffirms the need for the multi-strategy approach.
3. From the survey results, it is observed that only certain learning skills are achieved through certain assessment methods and not all learning skills could be achieved through a single assessment. The bottom line should be to choose a combination of assessment methods that can collectively encompass all the learning objectives desired for a course.
4. A strong need exists to conduct student surveys that focus mainly on the assessment components, as they help lecturers in understanding the student perspectives of learning and in improving the design of the assessment processes. In addition, it had resulted in a set of recommendations to improve the three assessment modes considered in this study.
5. This study resulted in another new observation that partnerships in curriculum form a good base to promote deep learning. The survey conducted in Step 4 revealed that an integrated assessment combining more than one course would facilitate deep learning. As a follow up to this, two IS courses, Systems Analysis and Design (which imparts software design knowledge) and Computer Programming (which imparts software implementation skills), were considered for such combined assessments in the subsequent delivery of the courses. A subsequent performance measure indicated that the combined assessment indeed helped the students to integrate related concepts and aided in their deep learning to a great extent.

The four-step student-centred approach has definitely helped the teaching team to identify, design, evaluate and, finally, improve a set of assessment modes for an IS course taking into account student learning perceptions. This approach would be a useful methodology for academic practitioners in addressing student-centred learning issues while adopting relevant assessment practices that could facilitate deep learning.

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APPENDIX 1: A Questionnaire on "Assessment Modes - How they influence Student Learning"

Give a rating for each item given below on a scale of 1 to 5, 1 being minimum impact and 5 being maximum impact. Circle one appropriate number for each assessment mode, namely, Lab Test, Written Test and Mini-Project.

1. The extent to which the following activity helps you to know your strengths and weaknesses of the course.

Lab Test	Written Test	Mini-Project
1 2 3 4 5	1 2 3 4 5	1 2 3 4 5

2. The extent to which feedback from lecturers help you in the learning process.

Lab Test	Written Test	Mini-Project
1 2 3 4 5	1 2 3 4 5	1 2 3 4 5

3. Towards sharpening your technical skills in the course.

Lab Test	Written Test	Mini-Project
1 2 3 4 5	1 2 3 4 5	1 2 3 4 5

4. Aids in creative thinking.

Lab Test	Written Test	Mini-Project
1 2 3 4 5	1 2 3 4 5	1 2 3 4 5

5. Towards Problem-Based Learning.

Lab Test	Written Test	Mini-Project
1 2 3 4 5	1 2 3 4 5	1 2 3 4 5

6. Level of learning from peers.

Lab Test	Written Test	Mini-Project
1 2 3 4 5	1 2 3 4 5	1 2 3 4 5

7. Contribution towards the level of student competitiveness.

Lab Test	Written Test	Mini-Project
1 2 3 4 5	1 2 3 4 5	1 2 3 4 5

8. Towards linking it with other areas / courses.

Lab Test	Written Test	Mini-Project
1 2 3 4 5	1 2 3 4 5	1 2 3 4 5

9. Level of help towards refining your own work.

Lab Test	Written Test	Mini-Project
1 2 3 4 5	1 2 3 4 5	1 2 3 4 5

10. Promotes self-directed learning.

Lab Test	Written Test	Mini-Project
1 2 3 4 5	1 2 3 4 5	1 2 3 4 5

11. Towards self-assessment of your learning.

Lab Test	Written Test	Mini-Project
1 2 3 4 5	1 2 3 4 5	1 2 3 4 5

12. Aids in performing a self-review of the course topics.

Lab Test	Written Test	Mini-Project
1 2 3 4 5	1 2 3 4 5	1 2 3 4 5

13. Towards attaining a deeper knowledge of the course.

Lab Test	Written Test	Mini-Project
1 2 3 4 5	1 2 3 4 5	1 2 3 4 5

14. Towards getting more interested in the course.

Lab Test	Written Test	Mini-Project
1 2 3 4 5	1 2 3 4 5	1 2 3 4 5

APPENDIX 2: Assessment Methods - Survey Results

Legend: Lab Test - LT, Written Test - WT, Mini Project - MP, Question – Q

Scale Impact	LT	WT	MP	LT	WT	MP	LT	WT	MP	LT	WT	MP	LT	WT	MP	LT	WT	MP	LT	WT	MP
	Q1 (%)			Q2 (%)			Q3 (%)			Q4 (%)			Q5 (%)			Q6 (%)			Q7 (%)	
1	0	0	4	0	0	0	0	2	0	0	20	0	0	6	0	0	40	0	0	16	0
2	4	2	16	0	0	0	10	20	0	20	34	0	0	48	0	4	60	0	6	20	4
3	14	16	24	10	12	10	30	38	8	40	26	16	40	30	10	54	0	10	10	10	12
4	72	70	52	54	60	50	32	40	42	26	20	48	54	16	50	42	0	52	62	48	56
5	10	12	4	36	28	40	28	0	50	14	0	36	6	0	40	0	0	38	22	6	28

Scale Impact	LT	WT	MP	LT	WT	MP	LT	WT	MP	LT	WT	MP	LT	WT	MP	LT	WT	MP	LT	WT	MP
	Q8 (%)			Q9 (%)			Q10 (%)			Q11 (%)			Q12 (%)			Q13 (%)			Q14 (%)	
1	10	14	2	0	0	2	0	0	2	0	0	0	0	2	0	0	16	0	0	8	0
2	18	28	10	10	0	8	4	0	4	6	2	4	6	4	6	20	24	2	0	38	0
3	28	40	24	12	12	16	10	8	22	12	8	20	12	6	20	26	42	6	40	30	8
4	38	14	54	52	54	62	76	80	68	74	78	70	74	78	68	40	16	52	54	20	50
5	6	4	10	26	34	12	10	12	4	8	12	6	8	10	6	14	2	40	6	4	42