PrODIMA: Programme Outcomes Data Integration, Management and Analysis in OBE Implementation

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ABSTRACT

This innovation has been motivated by the complexities of the present practice in analysing the data of the Programme Outcomes in the Outcome-Based Education (OBE) implementation. The present practice requires manual data collection, management and analysis. The process, which involves more than one personnel, faces the risks of missing data and mismanagement of the data which could lead to misinterpretation of the data. In addition, not only the process is time consuming, it requires massive use of paper and support staff resources for data entry and analysis. Thus, this innovation proposes an electronic solution that helps to minimise the risks and the use of resources as well as providing sufficient, reliable and fast results which can be used as performance criteria at the continual quality improvement (CQI) level.

Keywords: *Outcome Based Education, Programme Outcomes, Data Integration, Data Management, Continual Quality*

Introduction

The Outcome-Based Education (OBE) approach has been introduced in Institutions of Higher Learning (IHL) to meet the accreditation regulation set by the Malaysian Qualifications Framework (MQF). The approach requires programmes to be implemented in one close loop cycle, beginning with planning, implementation, assessment and ending with Continual Quality Improvement (CQI). Although the OBE approach is still at its infant stage in most of the programmes offered, the Faculty of Civil Engineering (FCE), being the first faculty implementing OBE in its programmes, has now reached the CQI level. This faculty is, thus, able to discuss its experience pertaining the OBE cycle. This paper, however, focuses on the assessment level as the writers feel that the FCE's experience can assist other faculties in assessing their own programmes.

In OBE, the assessment level involves assessing the Programme Outcomes (POs) so that it can be used as performance criteria at the CQI level. The FCE's experience has revealed that there has been no systematic method in assessing POs. The current practice shows that the process of collecting, managing and analysing the data is done manually and involves various personnel, ranging from the lecturers to the head of the programme. The long process of data collection and analysis often leads to the risks of data loss, mismanagement and misinterpretation, which eventually could result in wrong recommendation for the continual improvement. In addition, the manual process proves to be time consuming and requires massive use of paper and support staff resources for data entry and analysis.

Thus, there seems to be a strong need for a more systematic method of assessing the POs so that the whole process can be less tedious and more effective. The writers propose an electronic solution to help reduce the risks and problems identified in the present practice.

Programme Outcomes

Programme Outcomes (POs) is a key element in OBE implementation. ABET (2004) defined POs as statements that describe what students are expected to know or able to do by the time of graduation. The definition has been extended by Spady (1994) and he described POs as the ability to demonstrate learning, and involves performance of some kind of output in order to show significant learning. In other words, knowledge of content must be manifested through a demonstration process of some kind. Spady (1994) also explained the range of performance context at the lowest level as simple as demonstrations of classroom learning; and the highest level in demonstrating generic skills (that is, preparation of learners to be problem solvers, planners, creators, thinkers et cetera).

UiTM practices defined POs as the specific and general knowledge, skills, attitudes and abilities demonstrated by the programme's graduates. The programme outcomes incorporate technical skills and soft skills ability statements. Programme graduates are expected to have mastered the outcomes by the time they finish all the coursework in their programme (Academic Quality Assurance Unit, 2010). Scheming POs depends on the needs of faculties. However, the minimum requirement is to design the curriculum according to nine (9) learning outcomes as stated by the Ministry of Higher Learning (MOHE) as the following:
1. Knowledge
2. Practical Skills
3. Thinking and scientific skills
4. Communication skills
5. Social skills, teamwork and responsibility
6. Values, ethics, moral and professionalism
7. Information management and lifelong learning skills
8. Managerial and entrepreneurial skills
9. Leadership skills

All POs are then distributed in curriculum and delivered during classroom practices. Courses then are designed and embedded with POs to support the enhancement of students' technical skills, incorporated with soft skills. Academic members are responsible to design lecture contents and assessments so that students will demonstrate significant learning at the end of the courses.

Current Practices of POs Assessment

In conventional practice, students are not being assessed and evaluated for non-technical skills. Performance are assessed and graded based on their cognitive attainment for every semester. Marks are recorded and reported in the LE15 form (a standard form used in UiTM for recording and reporting the final examination marks). At the end of the semester, a student's learning achievement is made known by grade point average (GPA) and cumulative grade point average (CGPA). Any significant improvement of non-technical skills is not visible to the students for self- evaluation.

Nowadays, as a purpose of accreditation, OBE is implemented in our educational system. OBE stresses on outcomes of which any programme designed will focus on the key things students should understand and be able to do, or the qualities they should develop (Asmidar & Norshariza, 2007). In OBE, every programme is required to demonstrate the level of accomplishment by programme assessment and evaluation. All POs are measured in the LE15X form (refer to Figure 1). The assessment will give chance for immediate remedial work to be done if any setback occurs during the implementation in a stage of CQI.

MAKLUMAT PELAJAR		KERJA KURSUS (TECHNICAL PROJECT REPORT)						TEST			MARKAH DAN GRED AKHIR (LE15)						LE15			
	Man. Dsgn.	ESTEEM	Drawings	Descrptn	Present	Log Rep	JUM	Test 1	Test 2	JUM	KAKursus	Test	JUM	CATATAN			PO ASSESSMENT (%)			
Name	PO3 (10)	PO3 (5)	PO2 (5)	PO6 (5)	PO4 (10)	PO2 (5)	40	30	30	PO3(60)	40	60	100	GRED	POINT	KOMEN	PO2	PO3	PO4	PO6
NURFARAHN BINTI AZHAR	8.7	4.7	5.0	5.0	9.4	3.3	36.0	25.5	14.0	34.5	34	34.5	78	A-	3.67		83.0	70.4	93.8	100.0
NURUL A ADAWIAH BINTI MOHD AZIZ	8.7	4.7	5.0	5.0	9.4	3.3	36.0	24.0	21.5	45.5	36	45.5	82	A	4.00		93.0	79.4	93.8	100.0
SITI MAISARAH BINTI YUSOF	8.7	4.7	5.0	5.0	9.4	3.3	36.0	25.2	16.0	41.2	36	41.2	77	A-	3.67		83.0	72.7	93.8	100.0
SITI ZUHAIRA BINTI ISMAIL	8.0	5.0	5.0	5.0	9.4	3.3	35.7	10.8	14.4	25.2	36	25.2	74	B+	3.67		83.0	74.1	93.8	100.0
W MUHAMMAD FAIZ B W ABD MUHAAR	8.7	4.7	5.0	5.0	9.4	3.3	36.0	24.9	10.0	34.9	36	34.9	71	B-	3.33		83.0	64.3	93.8	100.0
WAN MOHD AIMAN BIN WAN AHMAD	8.7	5.0	5.0	5.0	9.4	3.3	36.3	13.2	8.2	21.4	36	21.4	55	C+	2.33		83.0	48.1	93.8	100.0
																	78.9	65.3	93.8	84.9

STATISTIK	KERJA KURSUS							TEST			MARKAH		
	Man. Dsgn.	ESTEEM	Drawings	Descrptn	Prog.Pres	Log Rep	JUM	Test 1	Test 2	JUM	KAKursus	Test	JUM
	PO3 (10)	PO3 (5)	PO2 (5)	PO6 (5)	PO8 (5)	PO6 (5)	40	30	30	PO3(60)	40	60	100
JUMLAH MARKAH	259	146	135	132	235	90	1016	727	415	1142	1016	1142	2158
PURATA MARKAH	8	5	5	4	8	1	33	23	13	37	33	37	79
MARKAH MINIMAL	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MARKAH MAKSIMA	9	5	5	5	9	5	36	27	25	51	36	51	82
BIL. PELAJAR MENGAMBIL	27	27	27	27	27	27	27	27	27	27	27	27	27

PO2: Ability to communicate effectively with technical personal and public
PO3: Ability to identify, formulate and solve engineering problems
PO4: Ability to function on multi-disciplinary teams
PO6: Ability to serve and contribute to the community and have an ethics for sustainable development for the nation.

Tandatangan Penyerah Rep. Akhir : _____
Disahkan oleh Wakil Jabatan : _____
Tandatangan Koordinator : _____

Figure 1: An LE15X Form for a Course

Assessments of the data collection and analysis process involve tedious work. Every course offered in a programme should measure its outcomes and normally it comprises of two or more outcomes. For higher semester courses, it will offer more. In the current practice, every question in assignments, tests and final examination delivers the required outcomes for the respective course. As a result, the management of the data collection and analysis becomes a critical issue. Generally, in completing the LE15X form and assessing the POs, there are four stages involved namely, data entry, data collection, data integration and data management. All the samples reported in this paper are taken from the current practice in the Faculty of Civil Engineering (FCE) UiTM Pahang.

Data Entry

Lecturers are responsible to coordinate at least one course from their programme in one semester but based on the necessity due to the increment in the number of students, lecturers are required to conduct more than one course. Every course that is entrusted to them has a variety and a number of POs.

For example, Figure 1 shows one course for one class in FCE that measures four POs which are (a) ability to communicate effectively with technical personal and public; (b) ability to identify, formulate and solve engineering problems; (c) ability to function on multi-disciplinary teams; and (d) ability to serve and contribute to the community and have an ethics for sustainable development for the nation. These four POs are assessed from the project report that consists of manual calculation, computer based calculation, and set of drawings, log book, presentation with professional engineers and tests. At the end of the process, the lecturer in charge of the course needs to collect and extract the total programme outcomes acquired by each student in the class in the LE15X form. Concurrently, the lecturer has to rehash the same process for other courses under their care.

Data Collection

All LE15X forms for the same course are collected by the course coordinator. Every member in the faculty has equal responsibility as the course coordinator and is liable for at least one course in the programme. As a course coordinator, the obligation to analyse every programme outcome for each student in the course is very complicated. The course coordinator needs to prepare a report of key performance for the course. The report scrutinizes the performance of programme outcomes for the course and any setback that occurs will be improved at the CQI stage.

In FCE practices, the course coordinator needs to manage between 40 students to 254 students for every semester. The course owner has to ensure the performance of the course is attained, that is, at least 80% of the students achieve 65% of the programme outcomes.

Data Integration

Data collected by the course coordinator will be sent to the Head of Programme (HP) or Programme Coordinator (PC). All results should be reported as percentage to enable comprehensive interpretation of the data. At this level, the HP has to manage the summary of data given by course owner at the macro level and document it as in Table 1. A good coordination is essential in order to get all data at the scheduled time.

Table 1: Example of Summary of PO Achievement

Code	Course	Programme Outcomes (%)								
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CODE 1	Course 1	65		66		55				
CODE 2	Course 2		70					72		73
CODE 3	Course 3		80		81					68
	Total PO for Part 1	65	75	66	81	55		72		70.5
CODE 4	Course 4	73					70		77	
CODE 5	Course 5			71		71				68
CODE 6	Course 6		82				52	73		
	Total PO for Part 2	73	82	71		71	61	73	77	68
CODE 7	Course 7		88	72					66	
CODE 8	Course 8	73				72	71			
CODE 9	Course 9				81			65		55
	Total PO for Part 3	73	88	72	81	72	71	65	66	55
CODE10	Course 10			57		63		78		
CODE 11	Course 11	89							79	75
CODE 12	Course 12		78		59		55			
	Total PO for Part 4	89	78	57	59	63	55	78	79	75
CODE13	Course 13		75	77					54	
CODE 14	Course 14	74				59		65		
CODE 15	Course 15			87	74				62	
	Total PO for Part 5	74	75	82	74	59		65	58	
CODE16	Course 16				77			82		84
CODE 17	Course 17		86	87			54			
	Total PO for Part 6		86	87	77		54	82		84
	Total PO for Semester xxx	74.8	69.1	62.1	74.4	64.0	48.2	72.5	56.0	58.8

Table 1 is the final presentation of the data integration process. The table shows students' PO performance for each semester and the overall performance for the programme.

Data Management

The last but essential stage is data management. Data that have been processed and compiled are subjected to analysis and interpretation. The results directly reflect the programme performance for that semester. Before any analysis can be made, each faculty has to set their own Key Performance Index (KPI). Setting KPI is done based on previous students' performances. If there is no data available, KPI can be modelled from other faculties which have established their KPI. Each PO that passes KPI indicates success. The HP will detect any PO that does not meet the KPI and remedial work has to be done.

The HP, first, identifies courses that indicate under achievement of PO. Memo will then be issued by the HP's office to relevant academic members. A meeting will be organized to discuss possible practices that have been inefficient. Suggestions on other methods or enhancements in delivery should be made. The resolution is then reported to the HP and recorded in the Continual Quality Improvement (CQI) document. Close monitoring will be done by the HP.

Similar practice can also been done at the course level. But at this stage, the course coordinator will be in charge for the documentation, report and progress.

The data management during this process, however, faces great difficulties when the HP is responsible in organizing data in two separates filing systems as described below:
1. Semester Performance
2. Cohort Performance

Semester Performance is as described in Table 1. On the other hand, Cohort Performance is the compilation of POs by the number of semesters beginning from students admission. After three years of study, the performance based on cohort will be made visible. Both semester and cohort performance respond as indication of programme achievement.

The problem, then extends when each student is to be issued with his or her individual POs performance at the time of graduation. The HP should be able to retrieve records, and provide POs achievement alongside students' final results.

However, things will be more complex when the programme is shared by other campuses. The data should be managed at a higher level by one authorized personnel in order to keep all data in place. Comparison study can be made possible if the faculties have efficient data management system.

All of the process will be faced by one faculty for one programme. If the faculty has more than one programme, the complexity of data management will increase exponentially.

PrODIMA: Solution for Programme Outcomes Data Integration, Management and Analysis

PrODIMA is an electronic innovation in enhancing the current manual system which has been used by FCE lecturers for adding or inserting students' marks based on their achievements every semester. The writers propose PrODIMA as the system will be able to save time and ease the lecturers' work by reducing and eliminating repetitive tasks. PrODIMA uses the client-server concept which means it can be accessed within and outside the organisation. PrODIMA allows ubiquitous technology of which lecturers can use the system at any place and at any time as long they have internet connection. Figure 2 shows a graphic illustration of the concept.
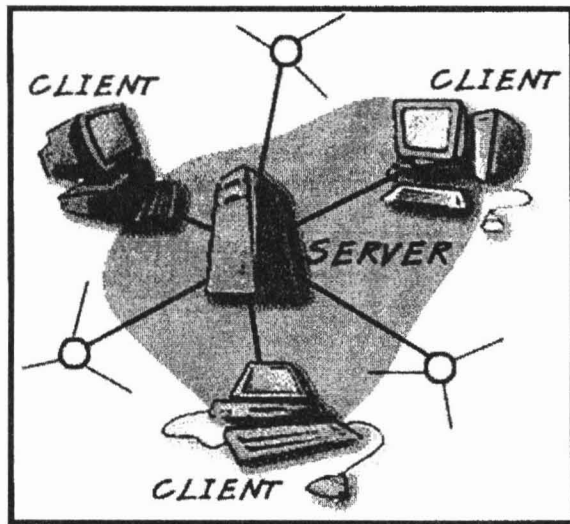

Figure 2: Client-Server Concept of Technology

The reason why the writers choose the client-server technology is based on their working experience. With the rapid application/system development and rapid technology hardware, a client-server concept provides hardware upgradability, long term cost benefits for development and lastly software compatibility with multiple or different vendor software tools for each application.

The system uses the XAMPP software which is open source software (OSS) that is available in the internet for free. The system employs PHP (PHP: Hypertext Preprocessor) as the programming language, HTML as an interface and MySQL as the database. Figure 3 shows the computerized process which has been simplified and designed to replace the manual.
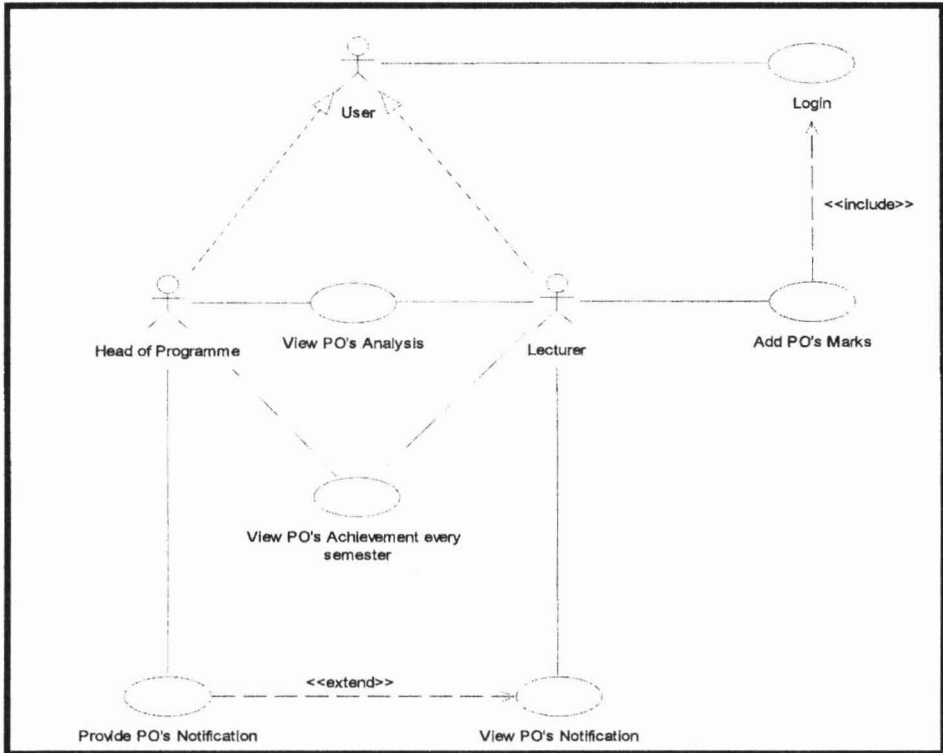
Figure 3: Use Case for PrODIMA

Users' Scope

PrODIMA involves two (2) users; the lecturer and the Head of Programme (HP). Table 2 show the users' scope and their ability on using PrODIMA in the future:

Table 2: Users' Scope

Lecturer	Head of Programme (HP)
Login	Login
Add POs' Marks	View POs' Achievement every semester
View POs' Achievement every semester	Provide POs' Notification
View POs' Notification	View POs' Analysis
View POs' Analysis	

     The lecturer will insert the POs' marks in percentage form for every semester and for each course. PrODIMA can calculate the average for each PO even when there are more than three (3) lecturers teaching the same course inserting the percentage data at the same time. Once the data have been completely inserted and filled, PrODIMA will automatically notify the HP on any PO which has not fulfilled the KPI requirements as an alert and advice to any course lecturer. Afterwards, the HP will send any notification or memo to the course lecturers to make an amendment and to improve the teaching and learning (P & P) process in the next CQI. The last feature provided by PrODIMA is the ability to view data analysis concluded by PrODIMA based for every semester for each course taken by the student.
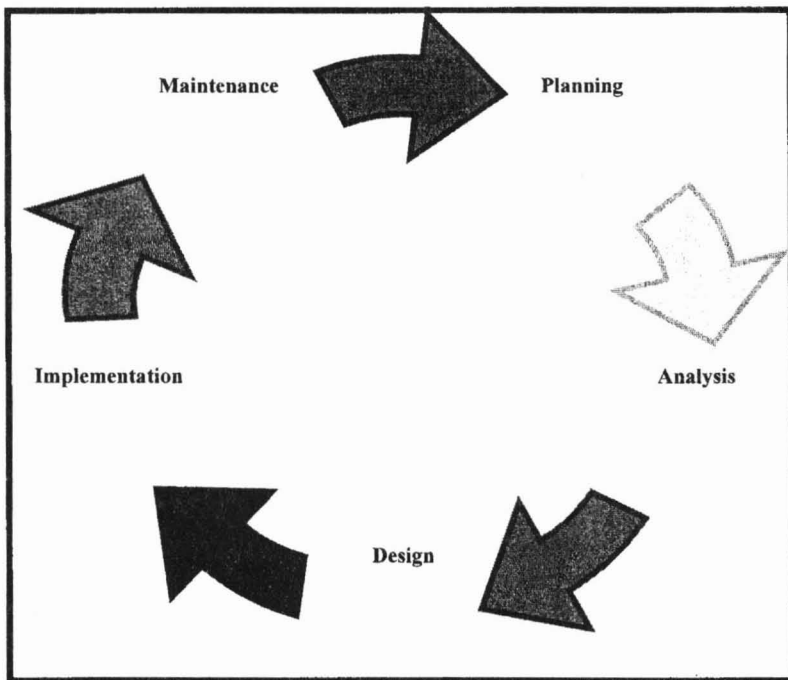
199

System Development

Figure 4: SDLC Methodology

The System Development Life Cycle (SDLC) has been used as one of the methodologies to develop the system. This SDLC involves five phases. Phase 1, *Planning*, is the most important part where users' requirements are gathered. These requirements can be obtained by examining related documentation and users' perceptions based on survey. Phase 2, *Analysis*, involves analysing all the data gathered based on the problems occurred that have been instigated before the development of the system. Analysing is the critical part to determine whether the system can be a success. Phase 3, *Design*, is where the system developer will focus on the logical design. Logical design defines the functions and features of a system (Shelly & Rosenblatt, 2010). Phase 4, *Implementation*, is the process on developing and constructing the system by generating the codes and producing a suitable interface for PrODIMA. In Phase 5, *Maintenance*, the system is not only maintained, but also enhanced for future consideration. Review of any problems that occurred during the usage of the system is also carried out in this phase.

System Output

As the final output, the system will be able to generate reports from the analyzed data within the system itself. Users can print the report based on POs' statistics, students' achievements and notifications produced for each course. System developers are also considering on producing the analyzed data in graph diagram to ease the understanding for lecturers and HP in the future.

Significance of PrODIMA

This system can facilitate in term of energy saving, efficient data management, user friendliness, online data entry, automatic analysis with real time report, and permanent record at a specific server. It also contributes to significant time reduction, reduced human resource and extended benefits that will be discovered in the future.

200

Conclusion

The complexities and the potential risks in the current practice in the process of data collection, data entry, data analysis and data management for the Programme Outcomes assessments have prompted the PrODIMA innovation. PrODIMA which stands for Programme Outcomes Data Integration, Management and Analsysis will be able to facilitate the process with its capability in reducing the risks and problems, as well as producing results efficiently for the CQI purposes.

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