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Innovation-enhanced rubrics assessment for final year projects

Nurfadhlina Mohd Sharef, Hazlina Hamdan & Hizmawati Madzin

Universiti Putra Malaysia
Serdang, Selangor, Malaysia

ABSTRACT: Rubrics provide standardisation in evaluation by specifying guidelines to assign marks according to predetermined evaluation criteria. Rubrics-based evaluation for the final year project in computer science has typically focused on the proposal writing, seminar, prototype development, logbook maintenance and dissertation writing. However, the evaluation has often overlooked the innovativeness of the project and the entrepreneurship skills of the candidates. This article addresses the gap in implementation of the final year project and introduces a framework of innovation-enhanced rubrics-based evaluation for the final year project. The new assessment framework emphasises entrepreneurship and innovation skills, which are realised as cognitive, affective, psychomotor and soft skills, as well as life-long learning characteristics in the course implementation. The new framework has resulted in candidates who have acquired the holistic attributes of excellent fresh graduates which are important and highly regarded by employers.

Keywords: Final year project, rubrics, innovation, entrepreneurship

INTRODUCTION

The completion of a final year project typically marks the accomplishment of a candidate in his undergraduate programme. The impact borne by the project is very important as it tests the ability of the candidate in idea construction, literature review, project analysis and design, and project development. In addition to software development skills, students are also evaluated for their writing through proposal writing and dissertation writing. Their presentation skills are also evaluated when they demonstrate their system and present a seminar. However, the project is carried out by many students across many departments and monitored by supervisors, and the standardisation issue has risen to ensure that all students are evaluated on the same scale. The previous practice was based on using maximum marks as guidelines, but this can still depend largely on the personal evaluation of the assessor. This limitation can be mitigated by adopting a rubrics-based evaluation.

Rubrics are defined as documents that articulate the expectations of an assignment by listing the criteria and levels of quality [1]. Rubrics have been utilised as a tool for standardisation of assessment by reflecting the processes and the content that are judged to be important. The defined quality provides a guideline for students to acquire and demonstrate skills, proficiency or criteria to attain a particular level of achievement. In addition to the formative assessment, rubrics also have the potential to teach and evaluate through a student-centred approach assessment.

Rubrics have been used in higher education as a formative assessment of an array of student products including oral presentations, concept maps, literature reviews, portfolios and projects [2][3]. The score achieved for each criterion is used for diagnostic feedback and promotes transparency in evaluation [4]. Existing studies on rubrics range from the use of edumetrics and psychometrics as competence-based assessment [5], perceptions of rubrics [6], the communicating criterion of rubrics [4], its application for general curriculum design [7], assessing employability skills [8], assessing scientific skills [9] and evaluating final year projects [10].

Rubrics-based evaluation has been incorporated in final year project (FYP) course assessment in the Faculty of Computer Science and Information Technology, Universiti Putra Malaysia, Malaysia [10][11]. The course has been designed to provide students with experience in practical project work and to assess student skills and competency in this field [12]. Therefore, several skills are tested, such as project management, software development, presentation and writing. However, the current implementation has not emphasised technological innovation and entrepreneurship. There

appears to be a global aspiration that students be equipped with such skills, so they can engage in business and have more holistic professional development. Also, this will be of benefit to their employers to ensure that students possess such skills. This study aims to fill the gaps noted above.

Although several, but limited existing works are available, none has studied on the innovation and entrepreneurship for computer science Bachelor's degree students. In fact, computer science and information technology is one of the mainstream players in technology innovation, such as solutions that involve embedded systems and robotic social media-based applications, where community problems inspire solutions.

Therefore, an innovation enhanced computer science final year project evaluation rubrics is presented in this article. The framework can also be applied to other disciplines which involve similar characteristics. The first part of the article explains the FYP implementation, followed by more detail in the second part on the practice, specifically focusing on the deliverables and maximum marks for each evaluation criteria. The following section explains the introduced rubrics for FYP. The conclusion section summarises the article and describes future work.

FINAL YEAR PROJECT ASSESSMENT

The FYP course is perceived by the students as the biggest development and writing task they ever experience during their Bachelor's degree study. This is because normally the FYP is conducted individually, even if the origin of the project is a sub-project of a bigger project plan. The FYP is, therefore, a significant benchmark of the depth of both theoretical and technical knowledge that students have acquired. The course is implemented through the standard supervision method, which means that students and supervisors work together as a team. The course is organised into three phrases; namely, pre-implementation, which consists of activities regarding the briefing for the course, setting up of the committee and the initial decision of the project title; implementation, which includes the literature review process, development and participation in the workshops; and post-implementation, which involves deliberation on the project.

However, the standardisation of the FYP evaluation has always been an important issue. The complexity of a standardised evaluation is made more challenging as this activity is spread across the departments in the faculty. Therefore, a rubrics-based assessment of FYP has been implemented in the Faculty of Computer Science and Information Technology (FSKTM), University of Putra Malaysia, Malaysia, to increase consistency of scoring, the possibility to facilitate valid judgment of complex competencies and promotion of learning. The Bloom Taxonomy has been used widely to classify the objectives into three domains; namely, cognitive, affective and psychomotor [13]. The rubrics act as the guideline for assessing student performance [6][14]. Rubrics have been used for many assessment aspects, such as life-long [15] and team work [16] evaluation.

Before rubrics were practised in FSKTM, the assessment was performed by assigning marks using a common set of assessment forms, but the assignment of marks was given according to the assessor's personal evaluation. This created some issues, for example, criticism of the credibility of certain students in obtaining high marks compared with their peers who had lower marks, although they deserved higher because their work was more appealing. In another situation, the rubrics make the management of the FYP more organised, especially in determining the best project across the departments. During the experience in developing the rubrics, several unnoticed requirements can also be spotted, such as enforcing quality checking on the projects, which indirectly contributes to the production of more competent students.

The FYP assessment in FSKTM is, generally, broken down into several deliverables, comprising the project proposal, dissertation, system demonstration, activity journaling in the log book, a series of workshop and a presentation. Table 1 shows the FYP assessment accountabilities and their full marks. The supervisor is responsible for 80% of the total marks (proposal, log book, project output and dissertation), the coordinator assigns 5% (workshops) while the evaluator assigns 15% (presentation). The details of rubrics characteristics and marks scale can be found elsewhere [11]. The rubrics are distributed to the students so they can prepare themselves for the expectations inherent in the evaluation.

Table 1: FYP assessment.

Proposal (10%)	Project output/system demonstration (30%)	Project dissertation (35%)	Presentation (15%)	Log book (5%)	Workshop (5%)
Project scope suitability with Bachelor degree. Clarity problem statement. Clarity project goal. The matching of the objective with the project goal.	Project output fulfils the objective in the given timeline. Suitability of the design of methodology/ approach/formula/ technique.	Abstract. Introduction. Literature review. Methodology and system design. Results and discussion. Conclusion, implication and	Introduction. Literature review . Methodology. Data interpretation, integration analysis discussion and results interpretation. Conclusion.	Involvement in supervision activity/project implementation.	Participation in briefings and workshops.

Expected result suitability.	Competency in developing the system. Ability of system to handle the problem statement and project objective. Testing on the system. Creativity and uniqueness of the project.	suggestion. References. Originality of writing.	Presentation style. Skill answering question.		

Rubrics-based assessment has resulted in a more standardised course assessment and monitoring. However, a few issues are on-going, which have encouraged a move towards innovation-enhanced FYP assessment rubrics, such as:

a) Assessment attributes for the dissertation and project presentation are similar, but the supervisor has to assess the same attribute twice. This has caused some consideration about extending the dissertation assessment to be performed by the examiners. However, this was not favoured in the post-course implementation meeting and, therefore, the presentation assessment attributes were changed to be more related to product pitching practice where students are required to promote their project. In this new plan, skills of entrepreneurship and innovation are emphasised. This plan was introduced because there was no innovative element in the FYP evaluation.
b) There is no emphasis on critical or real community problem investigation in the current problem statement assessment attributes. This is the main factor for students; they must settle on a less impactful and safer' project, which does not motivate them to push their competencies to the maximum and do not make any effort to come up with innovative solutions to problems. Therefore, innovation should be adopted for the problem statement to encourage students to find and suggest solutions to crucial community issues.
c) The students are also not exposed to entrepreneurial requirements, whilst equipping this knowledge would improve their competencies when entering the job market either as an employee or in order to become a technipreneur. Therefore, the new rubrics framework includes some business components, such as performing a survey or study on perspective customers and users. This will also require students to learn about existing competitors and solutions, which increase their exposure to market trends and demands, as well as technological advancements.

The above issues and motivations relevant to innovation-enhanced FYP assessment rubrics are also caused by students' exposure to several innovation competitions, which are held nationally and internationally, such as the Imagine Cup competition, FYP Talent competition, and the Institute of Higher Learning-Multimedia Supercorridor Startup competition. These competitions require several skills, including innovation and entrepreneurship skills, which have not been explicitly addressed in the current FYP assessment framework. Table 2 shows the assessment attributes of the FYP Talent competition, while Table 3 shows the assessment attributes from the IHL-MSC Startup 2013/2014 Competition.

Table 2: FYP talent competition assessment.

Problem statement (10%)	Solution design and innovation (35%)	Technical architecture and user experience (30%)	Business viability (15%)	Presentation (10%)
How precise and relevant is the real world problem?	Is the solution completely innovative or does it rely on an existing concept or technology?	System architecture, open to some evolution?	System architecture, open to some evolution?	Oral presentations that provide background and context to the project

Table 3**:** IHL-MSC start-up 2013/2014 competition.

Video pitch (40%)	Product/service/ technology description (15%)	Market and competition (10%)	Commercial viability (10%)	Idea innovativeness (15%)	Overall contents and document completeness (10%)
Demonstrates teamwork and ability to articulate overall value proposition. Adequately presents and discusses key points presented in Business Idea document. The presentation is	Clear problem definition. Solution demonstrates ability to deliver customer value. Displays uniqueness/ novelty of technology usage	Identifies target market, competitors, marketing strategies and plans. Identifies sales strategies and plans:	There is evidence that the business model is attractive in terms of potential margins, cash flow and value creation. Identifies sales strategies and plans. Possesses potential to go-to-market for	A new, fresh and original idea, strongly differentiated and unique, as well as a great solution to a current problem faced by the identified	Business Idea description is complete, comprehensive and adequately covers each section of business proposition and is coupled with an elevator pitch

able to attract the relevant stakeholders, shows a mix of strategic, analytical, execution skills and business plan have a reasonable likelihood of success: • Teamwork • Pitch content • Impact	proposition: • Problem statement • Problem ideas (solution) • Product uniqueness, competitiveness and record of recognition	• Target market and benefits of product	product/service commercialisation to secure investor to funding: • Business model	market: • Idea innovativeness	video presentation. Overall contents adequately articulate all relevant and pertinent issues related to the overall business proposition: • Overview • Organisations • Mechanics

RESULTS

In order to validate the importance of the proposed framework, a survey was conducted to obtain observations about the current FYP assessment implementation. Six questions were used in the instrument. Table 4 shows the questionnaire.

Table 4**:** Questionnaire for the observation on the current FYP assessment implementation.

Questions	Connection
a. Do you think the current FYP assessment rubrics include a criterion to measure students' skills in innovation and entrepreneurship?	-
b. Do you think it is important to identify the innovation and entrepreneurship skills amongst FYP students?	-
c. Do you think it is important to nurture the innovation and entrepreneurship skills of FYP students?	-
d. Do you think FYP students who pose innovative ideas and entrepreneurship skills should be credited?	-
e. Do you think students demonstrate any entrepreneurship and innovation skills during FYP?	If yes, answer f
f. In which stage of FYP implementation do you recognise the emergence of the skills?	Answer is the stages in FYP
g. How would you suggest incorporating the assessment of entrepreneurship and innovation skills in the FYP assessment rubrics?	-

The questions were designed to capture the perception of the respondents in terms of the current FYP assessment implementation from the innovation and entrepreneurship aspect (Question a). The questionnaire also aimed to ascertain their opinion on the importance of inducing the innovation and entrepreneurship criteria to the FYP (Questions b, c, d).

Question e identifies whether the respondents have observed any students possessing innovation and entrepreneurship skills, but who have not been assessed and rewarded. Question f is the continuation of question e, to establish the stage of demonstration of innovation and entrepreneurship skills among students. The last question (g) allows respondents to express their opinion on incorporation of the innovation and entrepreneurship skills assessment.

The respondents are the FYP coordinators from each department at FSKTM and supervisors who have experienced supervising participants for innovation competitions. The respondents are selected because they are the decision makers and they have initial insights into the difference of current FYP assessment framework and the innovation assessment criteria.

Table 5: Responses of the questionnaire for the observation on the current FYP assessment implementation.

Question	Yes (%)	No (%)
a	12.5	87.5
b	62.5	37.5
c	75	25
d	87.5	12.5
e	50	50
f	Proposal: 50 Project/system output: 33.3 Project dissertation: 0 Presentation: 16.67	
g	- Focus on completeness of the project, and marketability - During presentation and system demonstration - Expose students to entrepreneurship and innovation skills which are related to IT and computer science by providing training, workshop, etc.	

The results have indicated a strong need to incorporate the innovation and entrepreneurship skills assessment in the FYP assessment rubrics. Therefore, the authors proposed the innovation-enhanced final year project assessment framework as

shown in Table 6 to implemented. A few modifications to the current FYP assessment framework, such as marks weightage and rubrics criteria are indicated in italics in the table.

The modifications emphasis is on both entrepreneurial and innovation skills. For example, expectations for the problem statement, which is an attribute of the proposal are understanding the current state of the problem including why the problem occurs, clarity of problem statements, who solves the problem and the benefit of the solutions. The Bloom taxonomy is still used to scale the achievements of students.

Table 6**:** Innovation-enhanced final year project assessment.

Innovative proposal (15%)	Project output/system demonstration (25%)	Project dissertation (30%)	Presentation (20%)	Project management (5%)	Workshop (5%)
Suitability of project within the Bachelor's degree. *Relevant to real world problem statement.* *Important, unique and commercialisable project goal.* Objective matching with project goal. Expected result suitability.	Project output fulfils the objective in the given timeline. Suitability of the design of methodology/ approach/formula/ technique. *Knowledge and understanding of ideas.* Competency in developing the system. Ability of system to handle the problem statement and project objective. Testing on the system. Creativity and uniqueness of the project. *Innovative solution and value proposition according to the problem statement.*	Abstract. Introduction. Literature review. Methodology and system design. Results and discussion. Conclusions, implication and suggestions. References. Originality of writing.	*Project overview.* *Originality of project and innovativeness of ideas.* *Market potential and product positioning (entrepreneurship).* *Video pitch.* Presentation style. Skills in answering questions.	Involvement in supervision activity/ project implementation. *Knowledge in subject.* *Project management.*	Participation in briefings and workshops. *Idea sustainability.*

CONCLUSIONS

The article provides some highlights of the implementation of rubrics-based assessment of FYP in a computer science faculty. These are all in contrast to a rather more personal judgment of assigning marks, although the maximum mark is announced as a guideline. This is because the rubrics implementation has specified the expected quality in each of the criteria.

This approach has resulted many improvements against the silo and individual-based assessment performed before; such as 1) reducing the gap between the student's expectation in the learning outcome, as they know what is expected of them; 2) assisting the supervisors in coaching their students in FYP because the students are now aware of their expectations; and 3) helping the assessors to focus on each of the aspects being evaluated and guiding them in weighing up assignment of suitable marks.

Another advantage is that the assignment of marks according to the rubrics helps the supervisor and coordinator to identify the areas in which the students are lacking, and this observation makes performance analysis easier. However, since the increase in industry involvement with the university in shaping better graduates for employment, several competitions, which emphasise innovation and entrepreneurship have been conducted.

This practice has enabled identification of the limitation of the rubrics, especially in nurturing innovation and entrepreneurship skills, although there are some talents spotted among the students. Furthermore, innovation is now championed globally so that smarter solutions for the good of society can be introduced. Therefore, a preliminary study on the demand of incorporating these skills in the FYP assessment has been conducted.

In this article, the gaps between the standard rubrics-based assessment and the innovation competition have been highlighted. There was also discussion on some of the issues about the standard assessment framework and suggestions for an innovation-enhanced FYP assessment.

The new rubrics exhibit several observation characteristics across the FYP implementation, except for the duration of the project dissertation phase. This is because the project dissertation is focused on technical and academic writing skills. The other stages, ranging from the innovative proposal, project output/system demonstration, presentation, project

management and the workshop have now had elements added on the innovation and entrepreneurship, which will require the students to expand their horizon beyond a *traditional* faculty bounded projects.

These changes will contribute to an increased quality of the produced FYP and help shape more professional skills and attributes of students. This is also a contribution towards the life-long learning preparation of students who can qualify for both employment or who are self-business oriented.

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BIOGRAPHIES

Nurfadhlina Mohd Sharef received her Bachelor of Information Technology (BIT) degree from Universiti Kebangsaan Malaysia in 2003 before graduating with the Master of Science (Software Engineering) at the Universiti Putra Malaysia in 2007 and her PhD from the University of Bristol, in the UK in 2010. She is currently a senior lecturer in the Department of Computer Science at Universiti Putra Malaysia. Her main research interests focus on the intelligent systems, such as text mining, semantic web and recommendation systems. She has also developed an interest towards action research related to computer science education.

Hazlina Hamdan is a senior lecturer in the Department of Computer Science at Universiti Putra Malaysia. She graduated with a BSc(Hons) in Computer Science (1997) from Universiti Kebangsaan Malaysia. She holds a Master of Computer Science in Artificial Intelligence (2005) form Universiti Malaya and her PhD (2013) is from the University of Nottingham, UK. Her research areas are computational intelligent techniques and application, data analysis in health, agriculture and other domain, survival analysis and prediction.

Hizmawati Madzin obtained her Bachelor of Computer Science (Hons) from Universiti Putra Malaysia. Subsequently, she graduated with a Master of Software Engineering and a PhD from Universiti Putra Malaya. She is now working at the Faculty of Computer Science and Information Technology at Universiti Putra Malaysia, where she is a senior lecturer concentrating on image processing in the aquaculture field.