PROBLEM-BASED LEARNING (PBL) ASSESSMENT VS. CONVENTIONAL ASSESSMENT IN A PHYSICS COURSE: A PRELIMINARY FINDING

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Abstract— **The study is essentially an exploratory analysis, which sets out to obtain pattern of Problem-Based Learning assessment (PBLa) and Conventional assessment (Ca) that has been carried out in Faculty of Science and Natural Resources, Universiti Malaysia Sabah. The main objective of this paper is to scrutiny on how PBLa and Ca might contribute to students' performance that leads to their final grade in total. A physics course (Waves and Optic, SF10603) has been chosen since it involved two lectures that thought the course for seven weeks each. Data was gathered from three (3) consecutive different batches of students who registered for the course. The course is offer in every second semester in each session (i.e., 2011/2012 (n=34); 2012/2013 (n=60); and 2013/2014 (n=54)). For the first seven weeks student has been exposed with PBLa approach where it is one of the students-centered learning method. The second part of the seven weeks, another lecturer took over. Students were undergone Ca of teaching and learning activities since then. The data analysis carried out a pattern where PBLa approach showed a positive consistency in students' achievement compare to its counterparts. This paper also discussed type of assessments that carried out in PBLa and conventional approach.**

Index Terms—**Problem-based learning assessment; Conventional assessment.**

I. INTRODUCTION - COURSE ASSESSMENT

Malaysian Qualification Agency or better known as MQA was a body in charge for quality assurance of higher education on both in public and private sectors in Malaysia [1], and one of the obligations of this department is to sets standard for higher education institution (HEI) course assessment distribution according to the National Accreditation Board (Lembaga Akredetasi Negara, LAN). Therefore it is vital for Malaysian universities and colleges to meet the MQA's requirement and benchmark. Thus, it is important for lecturers

of universities and colleges in both public and private to fulfill MQA's necessity in particular pertaining students' performance (e.g., skills and academically). As it will reflect the credibility of program that offered. Universiti Malaysia Sabah (UMS) as well is not exempted, where one of the Faculty (i.e., Faculty of Science and Natural Resources (Fakulti Sains dan Sumber Alam) FSSA) is required to meet the standard.

TABLE 1. MQA Course Marks Distribution Guideline (Centre for Academic and Strategic Management, 2014).

Type of Assessment	Marks distribution guideline Percentage (%)
Assignment	10-30
Progressive Assessment (Skill)	5-10
Test/Quiz	5-10
Presentation (Viva Voce)	5-20
Mid Term Exam	20-30
Lab/Clinical Report	20-30
Field Work	20-30
Final Exam	30-50

Even though the MQA has sets a guideline of a course marks distribution as shows in Table1, it is up to lecturers to coordinate their course marks pertaining to their course requirement. Table 2 shows some of courses that offered in FSSA complete with marks distribution accordingly.

TABLE 2. Course marks distribution in Faculty of Science and Natural Resources in several courses selected.

Course	Assessment	Percentage (%)	Total
	Field Work	15	

Geology	Assignment/Lab/Report	25	100
	Mid Term Exam	20	
	Final Exam	40	
Aquaculture	Lab Report	10	100
	Assignment	10	
	Practical	10	
	Mid Term Exam	30	
	Final Exam	40	
Marine Science	Lab Report	15	100
	Assignment	15	
	Mid Term Exam	20	
	Final Exam	50	
Conservation Biology	Lab Report	15	100
	Assignment	20	
	Mid Term Exam	20	
	Final Exam	45	
Mathematics With Computer Graphic	Assignment 1	10	100
	Assignment 2	10	
	Mini Project	20	
	Mid Term Exam	20	
	Final Exam	40	

TABLE 3. Course marks distribution in Faculty Science and Natural Resources in general

No	Type of Assessment	Course Marks Percentage (%)	Total
1	Field Work	10 - 15	100
2	Assignment/ Lab/ Report	10 - 25	
3	Mid Term Examination	20 -30	
4	Final Exam	40 - 50	

It is clearly shows in Table 2 and Table 3 on weight of course assessment(s) in FSSA basically were based on pen and paper evaluation (i.e., mid-term exam and final exam, contributes almost 80%). Though there were marks contribute from field work/assignment/lab report which is reflect to students' competencies in handling study case, experiment etc., it is consider small contribution to the total marks. As stress by Astin *et al*., [2] assessment is most effective when it reflects an understanding as multidimensial, integrated, and revealed in performance over time. Astin *et al*., [2] adds learning is a complex process as it involves not only knowledge and abilities but values, attitudes, and habits of mind that affect both academic success and performance beyond the classroom. Assessment should reflect their understanding by employing a diverse array of methods (e.g., diverse actual performance; change and improve in their integration). These multiple diverse assessment is capable in improving students' learning experience. Additionally Affandi and Zanaton [3] emphasis in order for students to complete their academic task, constructivist learning (i.e., cooperative learning) active engagement in sharing and exchanging information and work supportively with each other is the key to an effective learning.

Hence, the present study was done to compare the difference between the constructivist assessments (i.e., Problem-based learning) and the conventional assessment which is more in traditional way.

II. THE ASSESSMENT

In this study two different approaches were taken into consideration as the independent variable, problem-based learning assessment (PBLa) and conventional assessment (Ca) as well.

PBL is a student-centred instructional approach in which students collaboratively solve problems, and reflect on their experience and practical knowledge. Characteristics of PBL are where learning is driven by challenging and open-ended problems. Students work in small collaborative groups where lecturer or teacher takes on the role as 'facilitator' of learning. Accordingly, students are encouraged to take responsibility for their group, organise and direct the learning process with support from a tutor or instructor ([4]; [5]; [6]; [7]; [8]). PBL approaches involve confronting situations where students are uncertain about information and solutions, and mastering the art of the instinctive leap in the process of resolving these situations [9]. Learning thus occurs through the application of knowledge and skills to the solution of authentic problems, often in the context of real practice [10]. PBL is a form of situated learning, and learning occurs through goal-directed activity situated in circumstances that are authentic in terms of intended application of the learnt knowledge. Advocates of PBL claim it can be used to enhance content knowledge and foster the development of communication, problem-solving, and self-directed learning skills. It is also an instructional method of hands-on, active, learning-centred education involving the investigation and resolution of messy, ill, loosely-structured problems, that one can find in real-world situations ([11]; [12]).

In this study, a model based on a combination of three models was employed: model that used by McMaster University [13]; the Torp and Sage Model [14]; and the model used by Pastirik [15] The main purpose of choosing a hybrid model was to ensure students explores their own learning, especially in terms sharpening their analytical skills, improving their critical justification in making decision, being a creative observer, and practicing their communication skills. All of these characteristics can be sharpened through these established learning models. Thus these PBL models were modified to suit undergraduate students particularly in UMS itself.

There are five main stages that consist in this PBL which are: i. Problem presented; defined the problems which is ill-structure and complex situation; ii. Student recognises learning issues and potential sources of knowledge and information; iii. Engage in independent study by gathering and analysing essential scenario information; iv. Student then meet with the small group, they critically discuss the practical application of the information to the scenario; and v. Student then critically reflect on both the content learned and the process.

In PBLa, the choice of assessment(s) implemented within a PBL curriculum has a powerful impact on student learning – when used effectively, assessment can promote and optimise student capabilities; when used unsuccessfully it can disempower students, undervaluing them and their work [16]. Pettigrew et al. [16] suggests a varies of assessment can be done within PBL approach that will maximise students competency such as case-based essays, written examination, concept maps, Viva voce, Triple Jump, written examinations, written reports, role plays, online "chat" forum, independent study report, Reference list oral representation, reflective journal and portfolio. Thus in this study, assessment were rearranged from previous research and were to fit to local context.

As for the conventional, the assessment was following the normal teaching learning and activities as they need to fulfil the faculty's standard of contact hours of lecturer class and tutorial and written examination. Additionally guided group assessment was given to students as well, in order for them to accomplish the course.The template is used to format your paper and style the text. All margins, column widths, line spaces, and text fonts are prescribed; please do not alter them. You may note peculiarities. For example, the head margin in this template measures proportionately more than is customary. This measurement and others are deliberate, using specifications that anticipate your paper as one part of the entire proceedings, and not as an independent document. Please do not revise any of the current designations.

III. METHODOLOGY

Before you begin to format your paper, first write and save The data was gathered from three (3) consecutive semesters starting from Session 2011/2012; 2012/2013; and 2013/2014. The course involves is Waves and Optic encoded with SF10603 with three credit hours per semester. The course only been offered in Semester II of each session to second year students, where two lectures handled the course with different approach respectively (i.e., Problem based learning assessment (PBLa) and conventional assessment (Ca)). Each lecture handled the course for seven weeks as in total of 14 weeks.

TABLE 4. Group sample for the study

Session	Number of Student (n)
2011/2012	34
2012/2013	60
2013/2014	54
Total	148

The PBLa and Ca assessments were the two dependent variables in this paper.

TABLE 5. Type of Assessment activities

Assessment	
PBL	Conventional

Problem/Issue Chosen	Guided Assignment
Continuous Evaluation (e.g., discussion, constructive engagement, etc)	Final Exam
Journal	
Final report	
Presentation	

In PBLa, students separated by groups (consist of 4-6 students) before proceed with the assignment.

At first group of student need to suggest a few issue in the first week. The issue must be genuine and authentic as can be found in their daily life activities. After engaged with several possible issues they discuss with the facilitator (i.e., Lecturer A) before proceed with the next step. This is important as the facilitator need to confirm first either the issue is adequate and acceptable to cover the syllabus for a particular topic within seven (7) weeks. After approval, students had undergone all the learning activities and assessment either individually or by group in total of seven weeks. The assessment were consists of discussion (online and offline) with facilitator and peers, constructive engagement, journal entry, final report and last but not least presentation. Lecture "A" gave a very brief lectures class every 2 weeks and the objective is to give student some direction on how to execute the assignment. Through this PBLa, the facilitator ensured that each group engaged with their learning activities by having discussion frequently. Monitoring students' progress and performance is vital as they need to be guided along the way, especially when they are really new about PBLa. Nevertheless, the guidance should be very minimal as it will not pamper students [17]. Besides of face to face class and discussion, facebook (FB) were used as the medium to convey information and knowledge among group members as well. During the learning process, students were engaged in variety of synchronous and asynchronous PBL learning activities, such as chat rooms; forum; sending and receiving e-mail from group members and facilitator; uploading their own materials to be used by other friends; downloading materials from the Internet; sending assignments and also get feed-back from facilitator. Since there were no fix times during the learning process, they can choose their own time to carry out all the activities through online or offline. The facilitator guided the groups cognitively in a collaborative atmosphere all the way throughout the 7 weeks. The guidance was in a very minimum direction, thus the facilitator only ask questions that only rise more inquiries to the students. They need to find their own answer by themselves and not getting it from the facilitator.

As for Lecturer "B" normal lecture class was done every week with an additional guided assignment was given. At the end of semester students sat their final exam as usual and total marks will be given consequently.

Data were gathered from both lecturers and was compared. Three batches of student group were involved (i.e., session 20011/2012; 2012/22013; and 2013/2014). The main objective of this analysis is to recognise the pattern of the students'

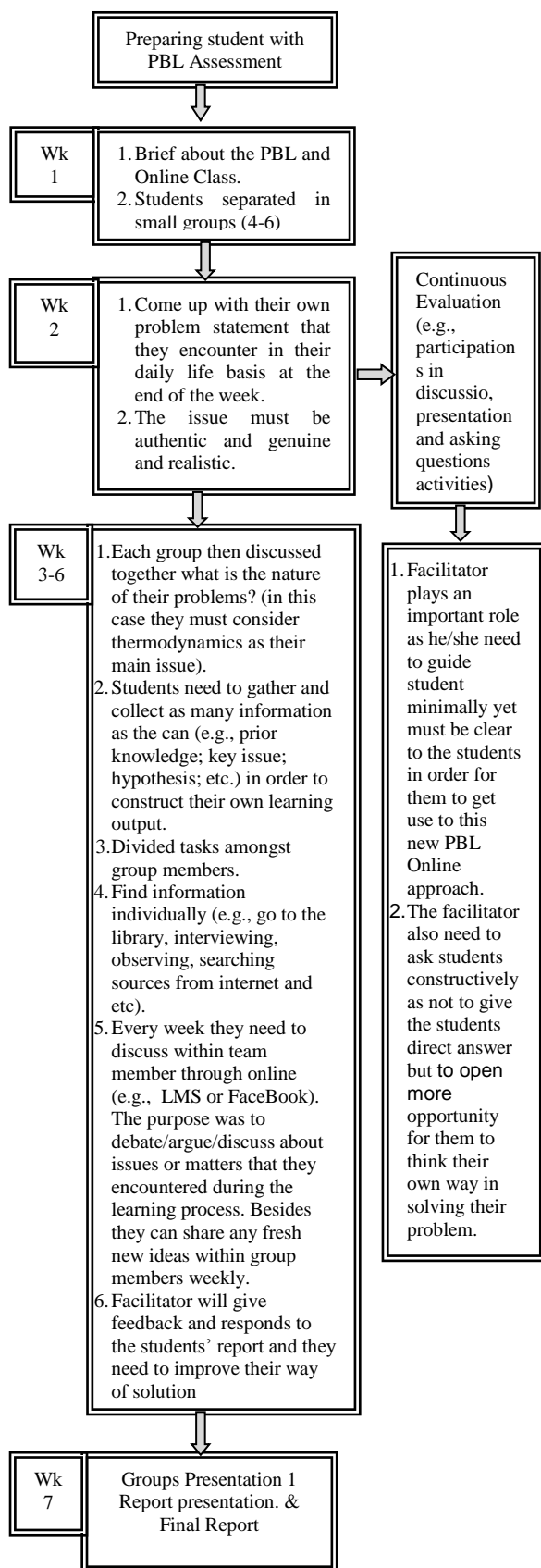results when assessing PBLa and Ca in a particular physics course.
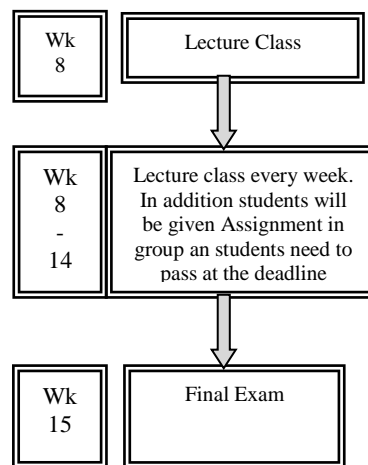
Fig 1. Flowchart of the PBL Assessment

| Wk 1 | 1. Brief about the PBL and Online Class.
2. Students separated in small groups (4-6) |

| Wk 2 | 1. Come up with their own problem statement that they encounter in their daily life basis at the end of the week.
2. The issue must be authentic and genuine and realistic. |

Continuous Evaluation (e.g., participations in discussio, presentation and asking questions activities)

| Wk 3-6 | 1. Each group then discussed together what is the nature of their problems? (in this case they must consider thermodynamics as their main issue).
2. Students need to gather and collect as many information as the can (e.g., prior knowledge; key issue; hypothesis; etc.) in order to construct their own learning output.
3. Divided tasks amongst group members.
4. Find information individually (e.g., go to the library, interviewing, observing, searching sources from internet and etc).
5. Every week they need to discuss within team member through online (e.g., LMS or FaceBook). The purpose was to debate/argue/discuss about issues or matters that they encountered during the learning process. Besides they can share any fresh new ideas within group members weekly.
6. Facilitator will give feedback and responds to the students' report and they need to improve their way of solution |

1. Facilitator plays an important role as he/she need to guide student minimally yet must be clear to the students in order for them to get use to this new PBL Online approach.
2. The facilitator also need to ask students constructively as not to give the students direct answer but to open more opportunity for them to think their own way in solving their problem.

| Wk 7 | Groups Presentation 1 Report presentation. & Final Report |

| Wk 8 | Lecture Class |

| Wk 8 - 14 | Lecture class every week. In addition students will be given Assignment in group an students need to pass at the deadline |

| Wk 15 | Final Exam |

Fig. 2: Flowchart of the Conventional Assessment

IV. FINDINGS AND DISCUSSIONS

From the graphs, it show pattern that can be considered for both assessments. Each graph can be divided into two parts of detail as follows:

TABLE 6. PBL and Conventional Assessment marks classification

Assessment	
PBL	Conventional
Marks > 0	Marks < 0

The graphs represent of marks different (Δm) between PBLa and Ca. This means, a same student had undergone both assessments accordingly. At the end of semester the different between these assessments calculated and analysed. The graph represent three sessions from 2011 to 2014 respectively involving three different batches.

The marks different present in the graph were stand individually. PBLa stated marks > 0, and Ca stated where marks < 0.

TABLE 7. The different between PBL assessment and Conventional assessment for Session 2011/2012

Session 2011/2012			Percentage different PBL > Conventional
Number of students where		Total number of students	
PBLa > Ca	PBLa < Ca		
27	7	34	79.4%

Graph 1: Session 2011/2012 (see Appendix)

Table 7 shows percentage of students where PBL assessment (n=27) states higher number of student compare to Conventional assessment (n=7) with approximately 79% indifferent. Graph 1 shows the different details individually.

Table 8. The different between PBL assessment and Conventional assessment for Session 2012/2013

Session 2012/2013			Percentage different PBL > Conventional
Number of students where		Total number of students	
PBLa > Ca	PBLa < Ca		
54	6	60	**90%**

Graph 2: Session 2012/2013 (see Appendix)

Table 8 shows percentage of students where PBL assessment (n=54) states higher number of students compare to Conventional assessment (n=6) with 90% indifferent. Graph 2 shows the different details individually.

TABLE 9. The different between PBL assessment and Conventional assessment for Session 2013/2014

Session 2013/2014			Percentage different PBL > Conventional
Number of students where		Total number of students	
PBLa > Ca	PBLa < Ca		
50	4	54	92%

Graph 3: Session 2013/2014 (see Appendix)

Table 9 shows percentage of students where PBL assessment (n=50) states higher number of students compare to Conventional assessment (n=4) 92% indifferent. Graph 3 shows the different details individually.

From the graphs and tables above, it is clearly indicates that students get better performance in total favour to PBL as compare to its counter-part (i.e conventional assessment). Though it's described in descriptively, it suggests that as far as the PBL assessment approach is concerned, students' active and variance performance in PBL might contribute to their total marks. This agreed with Fauziah and Saturi's [18] work where students who exposed with PBL learning activities performed better compare to assessment done conventionally.

V. CONCLUSION

This paper reports the finding of the Problem-Based Learning assessment versus conventional assessment when applied in a Physics course. The course that shared by two different lecturers has exposed students in two different approach for seven weeks each. In these two divert approaches students were undergone with a constructivist active learning activities (i.e., PBLa) that responsible to students' consistent performance, whilst the conventional assessment exposed students with normal teaching and learning activities (i.e., lecture, assignment and final exam). The result indicates student performed better in PBLa consistently for three (3) consecutive years as compare to its counter-parts. The activities arrangement ensures students engaged and took responsibility with their learning outcome under facilitation of lecture in charged [19]. Moreover Barret and Moore [20] stress it is very important for lecture/tutor only intervene in students learning activities in terms of process interventions rather that content interventions, meaning that students need to really construct their own knowledge by experience and not getting it easily from lecturers. Therefore the researcher is planning to implement the assessment in another suitable physics course in the future. Though the result is very much promising, yet it cannot be considered as the total outcome to represent the assessment as a whole. Many factors may contribute to the large different of the assessment marks such as students' perceptions, lecturers' perception, learning effectiveness, cost effectiveness, self-efficacy, self-confidence and cognitive factors [21]. Consequently the researcher has plan to extent the research in another related program to triangulate the findings.

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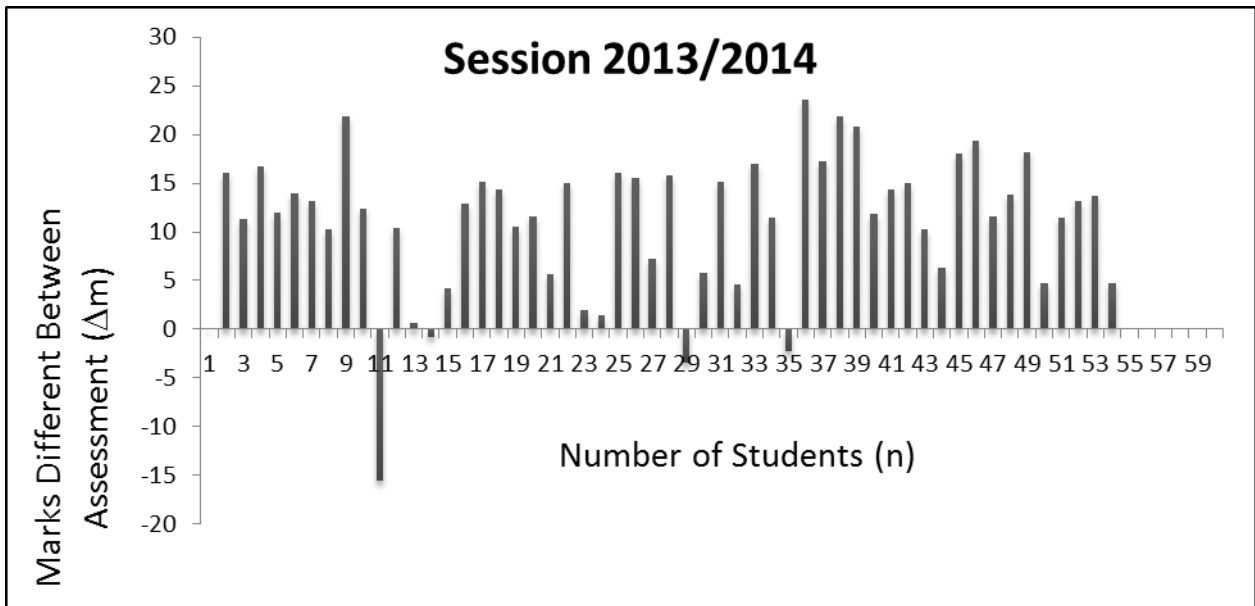
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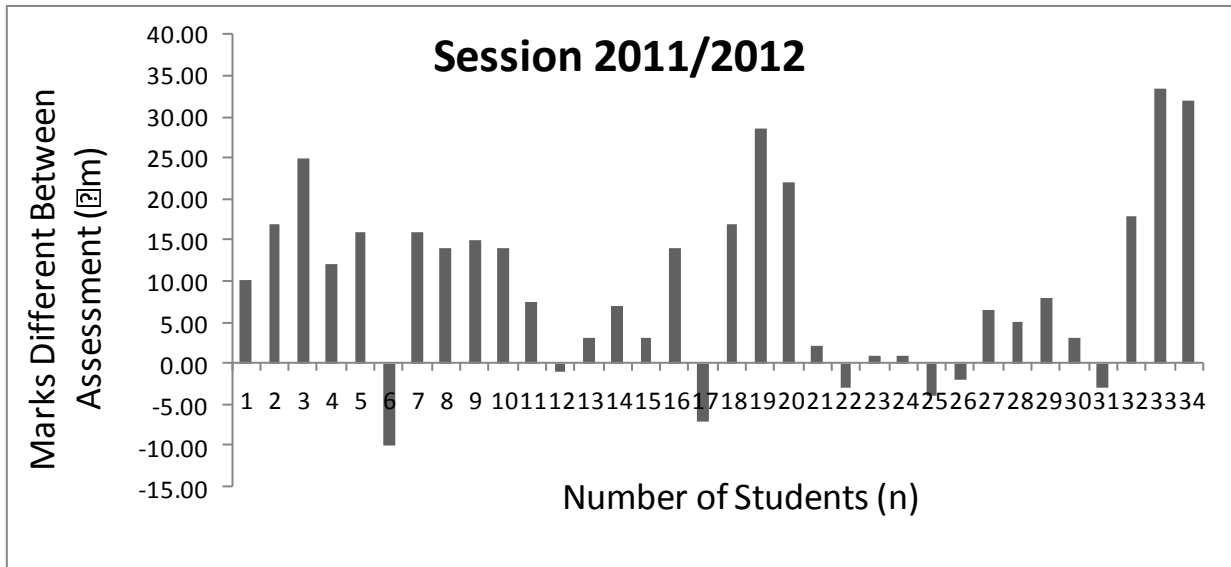
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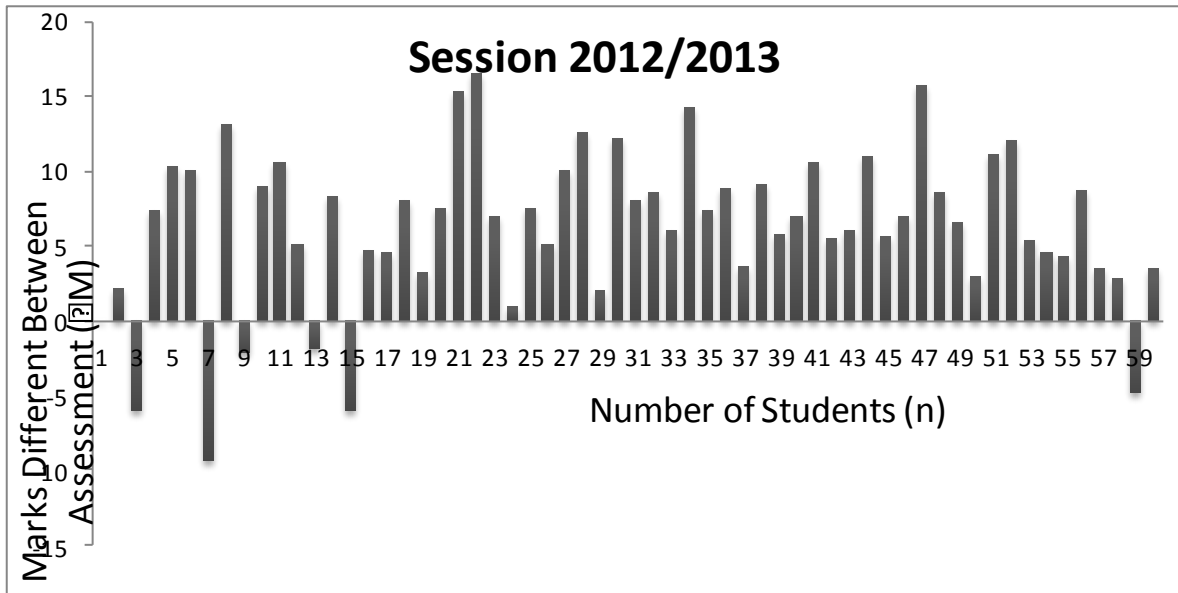
Graph 2: Session 2012/2013

Graph 3: Session 2013/2014