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Investigating the Relation between Student Engagement and Attainment in a Flexible Learning Environment

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***Abstract*—**The use of technology is increasingly adopted to support flexible learning in Higher Education institutions. The adoption of more sophisticated technologies offers a broad range of facilities for communication and resource sharing, thereby creating a flexible learning environment that facilitates and even encourages students not to physically attend classes. However this emerging trend seems to contradict class attendance requirements within universities, inevitably leading to a dilemma between amending traditional regulations and creating new policies for the higher education institutions. This study presents an investigation into student engagement in a technology enhanced/driven flexible environment along with its relationship to attainment. We propose an approach to modelling engagement from different perspectives in terms of indicators and then consider what impact these indicators have on student academic performance. We have carried out a case study on the relation between attendance and attainment in a flexible environment. Although our preliminary results show attendance is quantitatively correlated with successful student development and learning outcomes, our results also indicate there is a cohort that did not follow such a pattern. Nevertheless the preliminary results could provide an insight into pilot studies in the wider deployment of new technology to support flexible learning.

***Keywords*—**Engagement, flexible leaning, attendance and attainment.

I. Introduction

IT is widely accepted that student engagement is a major aspect in pedagogical studies, particularly in the context of higher education. It has drawn considerable attention in literature. Student engagement has presently become the latest focus of attention among those aiming to enhance learning and teaching in higher education. In [1], Trowler et al., published a literature review on student engagement, comprehensively describing the understanding, scope, typologies and categories of student engagement. In seeking to understand what is meant by 'engagement', some authors have defined the concept of engagement below:

- 'The quality of effort students themselves devote to educationally purposeful activities that contribute directly to desired outcomes' in [2].
- 'Participation in educationally effective practices, both inside and outside the classroom, which leads to a range of measurable outcomes' in [3].
- 'The extent to which students are engaging in activities that higher education research has shown to be linked with high-quality learning outcomes' in [4].

From the above definitions, we can identify two meaningful components, participation and learning outcomes. These components not only consider participation of learning activities, but also take the quality or effect of participation into account. A natural question here is how do we gauge the participation by means of quantified measures and can we define a set of indicators that can be effectively used to measure student engagement?

Traditionally class attendance is regarded as an indicator of student engagement. For example, if a student physically attends 100% of classes, then we say that the student has been well engaged with his/her study. However this view may be changing with the advent of technology enhanced/driven flexible learning, as the sophisticated technologies offer a broad range of facilities for communication and resource sharing, allowing students to conduct more self-directed study instead of physically attending classes. Given such a situation, it is compelling for us to consider what impact technology is producing on student engagement. Are there any other measurements that clearly or potentially indicate such impacts?

In [5], Harper and Quaye indicate that engagement does not only mean participation, it also requires feelings and sense making. The authors explain that 'acting without feeling engaged is just involvement or even compliance; feeling engaged without acting is dissociation'. They further categorise engagement into two dimensions in terms of behavioural engagement and emotional engagement. This categorisation provides us with a thoughtful clue to consider the development or establishment of relevant measurements for engagement.

In this study, we have characterised these into two categories of engagement by a set of meaningful indicators and proposed to model the relation of the indicators with student engagement and performance in the context of a pilot study. The pilot study is based on two year first and final modules, which could represent different aspects of engagement in relation to academic performance across different years. The pilot study focuses on developing a

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quantitative and pragmatic method to reveal the impact of a technology enhanced environment on student engagement, and then employs the results and methods to design a subsequent quantitative phase of large-scale studies to offer solid evidence that could be used for amending and developing new policies and regulations for class attendance in universities.

Due to limited information available, the case study is focused on investigating the correlation between attendance with regards to attainment and a comparative study between two different year groups studying different modules. In the meantime, we propose to project attendance and attainment paired into four divisions in terms of areas **A**, **B**, **C**, and **D** measurements, which can be used to address different issues, including retention rate, teaching quality and the impact of flexible learning.

II. Modeling

In a technology enhanced/driven flexible learning and teaching environment, associating attendance with attainment is only one aspect in investigating student engagement since the adoption of more sophisticated technologies facilitates communication and resource sharing, resulting in an increased number of students who do not physically attend classes. In order to obtain a quantitative idea of this cohort, we need some measurements to assist us in performing a quantitative analysis.

It is widely accepted that class attendance is a major indicator of student engagement. However with the advent of technology-enhanced/driven flexible environment, this view may be changing and many other indicators should be considered in order to measure student engagement in learning activity. Fig. 1 illustrates a model, identifying a number of possible indicators that can be used to measure student engagement. These indicators can be divided into two categories: behaviour and emotional engagement [6]. The first category includes attendance, Blackboard access and involvement, whereas the second category consists of attitude, presentism and so forth. Clearly the first category of indicators can be quantified in some way such as counting the number of classes attended and of blackboard access, however for the second category, we need to design a special approach to gauge their impact on engagement. This study focuses on the first indicator of attendance and use the blackboard access as an additional parameter to investigate the correlation between engagement and attainment.

III. Data Collection

In this pilot study, we used two modules from different years. The first was a first year BSc Hons of Information and Communication Technologies (ICT) module. The module was a standard compulsory module that ran in the first semester with 20 credits, 24 hours of lectures, 24 hours of tutorials and 48 hours of practicals. The assessment was composed of a progress test worth 30% and four pieces of coursework which

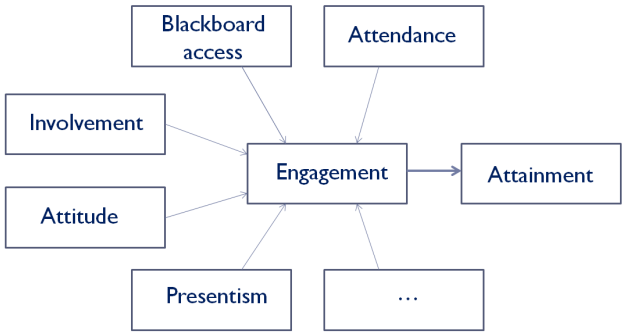

Fig. 1 A set of indicators of measuring engagement

were weighted at 70% in total. The number of students enrolled for the module in the 2010-11 academic year was 59, 77 for the academic year 2011-12 and 67 in 2012-13.

The second was a final year BSc Hons of Computer Science module. The module was an optional component that ran in the second semester with 20 credits, it comprised 30 hours of lectures, 6 hours of tutorials and 22 hours of practicals. The assessment method was coursework weighted at 50% and written examination worth 50%. In order to make a comparison with the first year module above, we collected three years data again. The number of students enrolled with the module in the 2011 academic year was 28, 33 for 2012 and 35 for 2013.

For both modules, we employed the same approach for data collection to enable fair comparisons to be made. At each lecture session, a sign in sheet was circulated in class, and students were required to sign their names and signatures as evidence of attendance. On average students were expected to complete 240 hours study for these modules, which were broken down into twelve weeks of teaching time, 55 hours of coursework time with 144 hours and 184 hours for students to complete outside of direct teaching in these two modules respectively.

IV. Empirical Analysis

We treat attendance and attainment as two different components and project pairs of components onto two dimensional space by a scatter method. According to the distribution of these pairs, we draw a trend using a linear regression method and then determine boundary points on the x-axis that represents attendance and on the y-axis that represents attainment. For the first exercise, we set 60% as a boundary point for reasonably good attendance and 40% as a minimum score point for passing modules. However we have to stress that the attendance was an average and there was a variation in attendance pattern among individuals in the attainment band. Thus the divisions in the attendance bands may be arbitrary, but nonetheless appear reasonable.

Fig. 2 illustrates analysing results of the first year students in the 2012/2013 academic year. Two different boundary points partition the two dimensional space into four areas labelled with **A**, **B**, **C** and **D**. The correlation for each of these areas and a trend across these areas are separately calculated by Spearman's rank method.

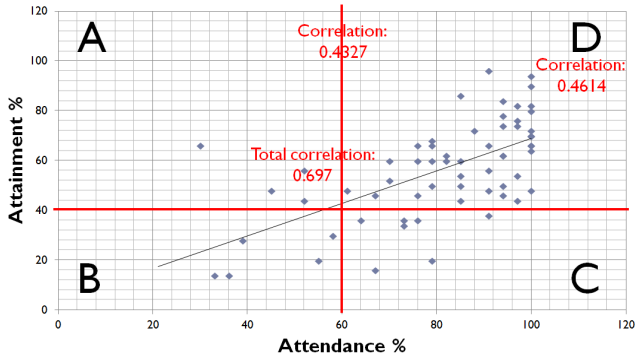

Fig. 2 Correlation and divisions of attendance and attainment (2012/2013)

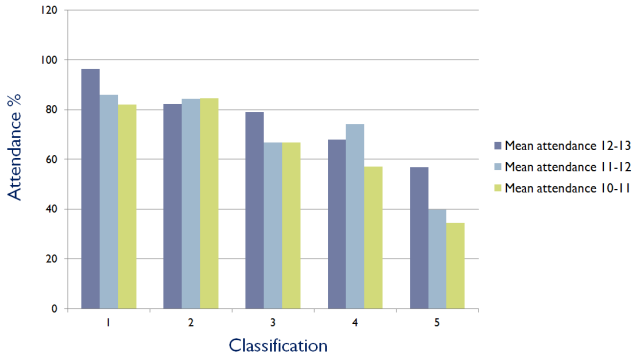

Fig. 3 Classification versus average attendance for the first year students across three years

There is a very clear correlation between attendance and attainment in this module. The results presented show the total correlation coefficient between attendance and attainment of these areas is 0.697, the correlation between attendance and attainment in the areas of **A** and **B** is 0.4327 and the correlation in **D** is 0.4614. These correlations are statistically significant with a 0.05 confidence level, therefore they are unlikely to be due to chance.

It should be noted that although the pairs are more concentrated on area **D**, the correlation here is smaller than the total correlation coefficient. This phenomenon reveals that the correlation between attendance and attainment in this area is not linear. We need to investigate a more sophisticated method to uncover the relation between them. Nevertheless the coefficients already show class attendance is closely associated with attainment performance.

It can be observed that despite lower attendance in area **A**, this cohort still achieved reasonable marks, one of them even achieved a 2:1 grade. This is noted as an anomaly, which appears to be inconsistent with the majority of the cases presented in area **D** and intuitively is difficult to explain. In this study analysis has not been carried out on individuals who are within area A or close to boundaries of the divisions selected to explore any possible influence on the findings due to lack of data. However when taking into account the flexible learning factor, we could conjecture that a technology enhanced flexible learning environment would play an important role for the cohort to achieve such decent results.

In fact, the four areas presented in Fig. 2 can serve different purposes. For example, area **A** represents a case where attendance is lower but attainment is reasonably good. In this situation we can use it to address what role a flexible learning environment is playing in student engagement. Area **B** exhibits a situation where the lower attendance directly affects the academic performance of students. We can use this as an early warning sign for tutors or course directors to act on such a cohort and improve the retention rate of students. The students in area **C** show that students' attendance is good, but their marks are poor. In such a situation, we may need to investigate either the quality of teaching or student engagement or both.

Fig. 3 presents a more detailed breakdown of average attendance (%) and examination marks for three years. In this case the marks are grouped into grade classifications, where scale points 1-5 on the x-axis correspond 1st class, 2:1, 2:2, pass and fail, respectively. With only a few exceptions it can be seen from the figure how, as attendance drops, so does the likelihood of a student gaining a higher classification and the following patterns have been obtained.

- Average attendance of 1st class students over three years is 88%;
- Average attendance of 2:1 students over three years is 83%
- Average attendance of 2:2 students over three years is 70%
- Average attendance of pass students over three years is 66%;
- Average attendance of fail students over three years is 43%.

The attendance rates above are averages, exceptional individual cases have been compromised. As can be seen from Fig. 2 those students within the 1st class category (marks of 70% or above) and the 2:1 classification (marks between 60-69%) have considerably higher attendance rates than those students at the lower classifications, in particular compared to fail students. It is likely that these students have advanced study skills and are therefore conducting their independent study in conjunction with the lecture courses. However, the differences between the boundaries of the 1st class and 2:1; 2:1 and 2:2; as well as between 2:2 and pass are not marginally large.

The above patterns are further supported by the correlations between classification and average attendance in each year as illustrated in Fig. 4, where the correlation coefficient of the 2010-2011 academic year is 0.949, in the 2010-2011 academic year it is 0.869, and in the 2011-2012 year it is 0.98.

Fig. 5 presents a projection of pairs of attendance and attainment rates onto a two dimensional space for the final year students of the 2013 academic year. Compared with Fig. 1, it can be seen that all the correlation coefficients in the four areas are smaller than those shown in Fig. 1. These coefficients signify that the correlation between attendance

and attainment is not as strong as in Fig. 1. Particularly from area **A** it can be observed that although the projected students in this area had less 60% of class attendance, the majority of them achieved either 1st class or 2:1 classification. This decline of attendance suggests that the learning behaviour of this cohort has changed in the sense that they may have turned/engaged in making use of the flexible learning environment for their module study. It may be that after three years of study, final year students have developed their independent study techniques and skills, and it is very likely that they will use more independent or interactive ways to conduct their study rather than solely relying on class attendance. Furthermore, perhaps it may be related to the emphasis of the learning outcomes for first and final years, where the final year module features more emphasis on evaluation, integration and synthesis of knowledge and skills, rather than knowledge and understanding of topics and essential skills, as required for the first year students.

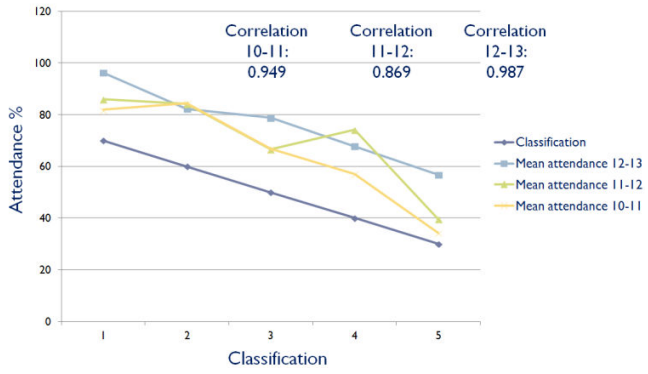

Fig. 4 The relation between classification and average attendance

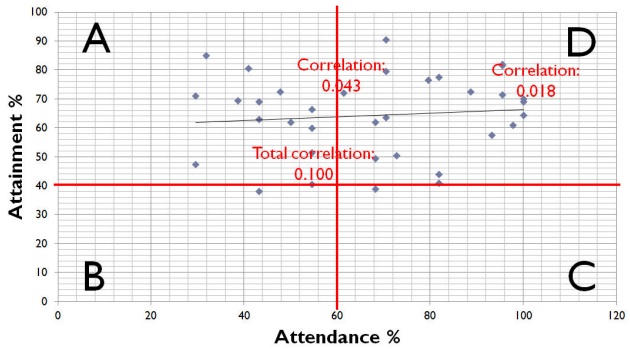

Fig. 5 Correlation and divisions of attendance and attainment (2013)

Fig. 6 presents a grade classification 1-5 (corresponding to 1st, 2:1, 2:2, pass and fail) versus average attendance for the final year students across the 2011, 2012 and 2013 academic years. From this diagram, the following statistics can be obtained.

- Average attendance of 1st class students over three years is 78%;
- Average attendance of 2:1 students over three years is 73%;
- Average attendance of 2:2 students over three years is 74%;
- Average attendance of pass students over three years is 74%;
- Average attendance of fail students over three years is 48%.

The above findings are supported by the additional correlation between classification and average attendance as presented in Fig. 7. From the figure we can observe that the correlation coefficient of the 2011 academic year is 0.88, the 2012 academic year is 0.681, and the 2013 is 0.758.

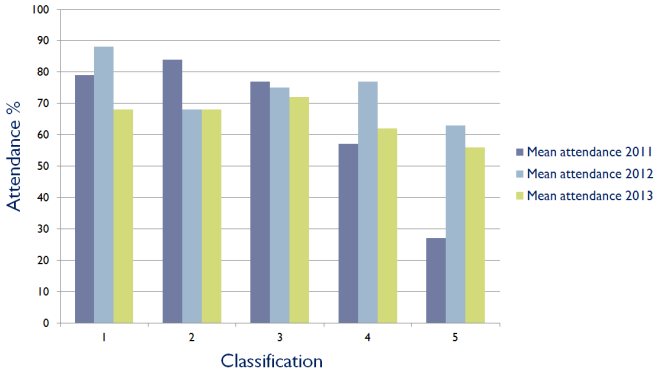

Fig. 6 Classification versus average attendance for the final year

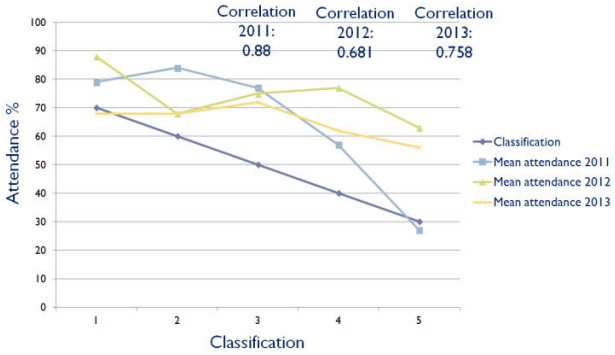

Fig. 7 Correlation between classification and average attendance

Comparing Figs. 3 with 5, it can be seen that the attendance rates dropped 10% for the 1st class and 2:1 category students, however the average attendance increased 4% for 2:2 grade students and 8% for pass students. Comparing Figs. 4 and 7, the correlation between attendance and attainment decreased 0.06, 0.18 and 0.23 across three years respectively. These findings seem to be consistent with our general perception that the final year students have developed their independent study abilities and skills. It is noted that the difference of attendance rates for the final year students is very small, which seems to indicate that class attendance became less important with regards to final year students.

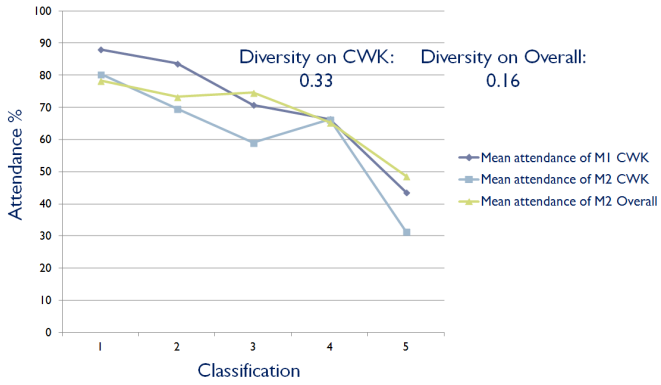

Fig. 8 Mean diversity between the two modules

To quantify the similarity of learning behaviours between the first and final years, we have employed the Discrete Frechet distance to measure the degrees of similarity between the two measurements; mean attendance from the two modules against classification. Fig. 8 presents the mean difference in the form of distance measurements among the tree curves overall classification, i.e. how the average attendance relates to the coursework results and the combined coursework and examination mark. As indicated the relation between two pieces of coursework scores over the two different years is weaker than that between the coursework and the overall marks, which means it would be sensible to compare the coursework as an overall in the first year with an aggregated result in the final year.

V. Summary

In the study, we have presented the results of the analysis and comparative studies of the relation between attendance and attainment for first and final year students. We have proposed a viable approach to project students into a two dimensional space based on the components of attendance and attainment and partition the projection of the components into four areas, which can be used to address different teaching and learning issues.

For example, using area **A** we can investigate why a cohort with less than 60% attendance rates can succeed and even achieve the 1st and 2:1 grades. In this case, we assume that the flexible learning environment may play an important role in helping students engage with their studies. To validate this assumption, we could study how many times the students have downloaded module materials from Blackboard. Another example is to improve retention rate, we can use area **B** as a trigger points for action. In addition we can use area **C** to study teaching quality, student attitude and ability, and so forth.

The analysis results have shown a strong correlation between attendance and attainment and are therefore consistent with the findings reported elsewhere [7, 8]. The results have also revealed that the attendance rates dropped approximately 10% from the first year to the final year students. This finding corroborates the general perception of learning behaviours of students that the students in the final year have advanced study skills, and have therefore had the independent ability to conduct their own studies in conjunction with the lecture courses. Furthermore the difference between the attendance rates over classification was very small for the final year students in comparison with the first year students. This raises an issue of student engagement on the module study and lecturing effect, which clearly indicates that class attendance alone is not an adequate measurement of engagement. As suggested in [6], engagement involves feeling and sense making along with accessing direct or indirect materials.

The demonstrated patterns of results from this study are not entirely expected. The quantified relation between attendance and attainment has shed a light on what effect class attendance has and what impact flexible learning will have on student engagement. This pilot study needs to be scaled up to ascertain if the conclusion drawn will hold in the general context of an university, thereby providing a solid basis for the university to reformulate the investment of learning facilities to develop a technology enhanced/driven environment for supporting flexible learning.

Acknowledgment

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