

Does Online Engagement Improve Students' Performance in a Large Classroom: Empirical Evidence from a Microeconomics module at University of Sheffield International College during the COVID19 pandemic

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Abstract

This paper investigates the association between students' online engagement and their performance in a HE (level 6) compulsory Microeconomics module. The data for this study comes from a unique purpose-built student online survey with a large cohort of 282 students in University of Sheffield International College (USIC) in England. The dataset was also matched with college administrative data to access students' performance records. Students' performance was measured from their end-of-term summative assessment score in the module. Multiple Regression analysis was used to identify the relationship between students' engagement and performance. The findings show a positive and significant relationship between online engagement (performance in formative assessments and use of discussion boards) and performance (end-of-term score). This study also provides useful insights by informing as to what works best for students in large classrooms regarding their engagement.

Keywords: *Student engagement; performance; online learning; HE; pandemic; large classes*

1. Introduction

To contextualise the current study within the wider HE context, higher levels of student engagement is relevant and can be seen as measures of success for students, teachers, programmes and higher education institutions themselves. Higher engagement levels are important for quality student experiences. Therefore, education researchers and stakeholders are keen to know about student engagement in higher education for various reasons including competition (Vuori, 2014). The current study is particularly concerned with looking at students' perspectives by asking a range of questions about activities related to multiple dimensions of engagement. There is a deliberate focus on self-reported measures in order to gain students' subjective experience which their course has prioritised, thereby identifying specific areas where the relevant institution can make further progress and enhance if appropriate and possible.

This paper investigates the association between students' online engagement and their performance in a HE (level 6) compulsory module of Economics: Microeconomics. The data comes from a unique purpose-built student online survey (282 students) collected from University of Sheffield International College (USIC) in England. The dataset is also matched with administrative data of the college to access students' performance records. Students' performance is measured from their end-of-term summative assessment score in that module. Multiple Regression analysis is used to identify the relationship between students' engagement and performance. This paper proceeds as follows: section 2 reviews previous literature before and after the pandemic, section 3 and 4 describe the data and methodology, section 5 presents the results and section 6 concludes.

2. Description of the Teaching/Learning Context

The data comes from a purpose-built, semi-structured online student questionnaire conducted using online google survey forms during virtual sessions. The online student survey was sent to all (311) pre masters, level 6 students studying a course in their term 2 (started from Jan 2021) in Microeconomics course at University of Sheffield International College (USIC) UK. Out of 311 students, 282 responded to the survey, having a 90% response rate. The international pre masters programme consists of three terms: **term 1: Sep term** which started from Sept 2020, there is no Economics in term 1. **Term 2: Jan term 2021**: students study a compulsory module: Microeconomics in this term. **Term 3: April term** that starts from April 2021 and students take another Economics module: Macroeconomics. Usually, each term lasts for 8-9 teaching weeks followed by the end of term exam period. This course was the largest module among all other modules and programmes. This large cohort is arranged (300 plus students) as having a combined lecture together (2hrs) in a lecture theatre and two teaching sessions (seminar 1(1.5 hrs) and 2 (1.5 hr)) delivered as small teaching groups (around 20 students class size each, so in total 15 groups.)

The module is mandatory for both pathways: Economics and Business. The delivery of the module is achieved using a blended learning approach involving VLE- based distance learning, traditional face to face teaching and a combination of both. Table 1 below provides the description of termly learning hours for this module.

Table 1. Breakdown of termly Guided Learning Hours

Teaching and Learning activities	Indicative guided learning hours per term
Asynchronous Learning: Guided VLE activities, independent study, assessment preparation	42
Synchronous Learning: Live classes, small group workshops, support	18

All students studying this course are international students. It is very important to study the students' progress/performance in this course in the pre-masters programme as this maps the students' transition from University of Sheffield International College (USIC) to the University of Sheffield and this aids the student's preparation for their master's degree at university. The overall aim of the module is to introduce students with no prior background in economics to the subject-specific language and study skills. The module provides students with some basic and intermediate concepts and theories in economics. Hence, this will enable them to acquire the appropriate knowledge to progress with confidence onto their chosen master's degree programme at the University of Sheffield.

Students were asked (through student questionnaires) to provide their student id numbers which helped the author to match students' self-reported engagement perceptions responses and demographic variables from the mid-term questionnaire to the University of Sheffield International (USIC) administrative central management data that contain their attendance, term scores and other information etc. The student questionnaire is attached in Appendix 1, containing detailed information about the range of questions asked to students. Therefore, it is quite a comprehensive and rich dataset to assess the underlying research question. The reliability of data comes from the fact that students were not asked about their scores, instead student id collected from respondents were used to get their score and other records so reducing the chance of reporting error and manipulation.

Like face-to-face discussion, discussion boards are reflective in nature, a powerful tool in an online environment, VLE and allow students to think critically about the seminar topic throughout the week and support the points well, also moving the discussion on by responding to other students' contributions. Given the context of international students, it is also a good tool to gauge students' opinions especially for new students particularly the quiet ones. However, reviewing students' responses in large cohorts poses a challenge for educators. This has been dealt well by allowing students to use discussion boards in seminar sessions where a teacher can manage around 20 students' views.

Formative assessments (assessment for learning) progress tests that involved multiple types of questions, short questions and answers, calculation, MCQs were used. All these were linked with their summative assessments, SA (unseen exam). The biggest challenges were that these are very time consuming to mark and required data tracking particularly with a large cohort such as this where the teacher has to offer one to one feedback. Feedback, should be timely (Haunt and Pellegrino, 2002) and smart as formative assessments may not be meaningful if the teacher cannot identify, analyse, and respond to the problems of individual students. The intuition behind using FA as a measure of student engagement is that progress tests are useful to obtain feedback as to what the students have learned. For students, these tests are an opportunity to show what they have learned and the extent and depth of their knowledge. Also, a teacher's ability to develop FA and feedback should be strong, consistent, and nurtured. Given the nature of international and large cohorts and differences across time zones both discussion board and FA were built in with sufficient time allowing students to respond at their own time.

The table 2 below gives the definition and description of variables and how they are constructed in present study.

Table 2. Description of Variable and Summary Statistics of Variables used in the study

Definition of variables used in present study
Dependent variable
End-of-term student performance measured as marks obtained in summative assessment of Economics course.
Independent variables
Gender a binary variable: 1= Male, 2= Female

Indicators of engagement	
Engagement 1:	Percentage of attendance in live teaching sessions (including lectures and seminars) during the term.
Engagement 2:	Average score in four formative assessments (online progress class tests) during the term.
Engagement 3:	Student use of online academic discussion board in response to teacher posted questions during the term.
Engagement 4:	Student motivation measured as their self-reported perceptions/beliefs of their engagement during online classes measured as a composite index consisting of an average of three sets of items (Q1 excitement, Q2 involvement, Q3 participation). These questions were asked to students in an online mid-term survey and their responses were recorded on 5 points Likert scale.
Sample Size	172 students

2.1. Data Ethics and Confidentiality

This project was approved by The School of Education's ethics review procedure at the University of Sheffield. Students were informed that taking part in the project would include completing a student questionnaire and that responses would be matched with their term scores and other records using their student id. Students were provided with a detailed project information sheet outlining the title and descriptions of the project, why they were chosen as a participant, as well as information about confidentiality, data control, the legal basis for processing data and a consent form. Also, they were told that submitting the questionnaire would be taken as them providing informed consent.

Students were given a certain date to withdraw from study after the data collection and were assured that they did not have to give any reasons for why they no longer wanted to take part and that there would be no adverse consequences if they choose to withdraw. Few students submitted their responses at the end of the week as most students completed the survey during lecture time.

3. Literature Review

Student engagement is defined as an active participation in the education process along with feeling and sense making that require a positive frame of mind (Harper and Quayle, 2009) and is considered an indicator of institutional quality (Kuh, 2001). An excellent undergraduate education is most likely to happen at the colleges and universities which are successful at enhancing student engagement through maximising good practices (Pascarella, 2001).

Looking at literature, it is evident that it is vital to analyse student engagement from a student's perspective. Harper, (2007; 2011) describes that the most important and efficient method to enhance student engagement is to call for those students who are educationally less engaged and ask their opinions and experiences. Therefore, it is highly recommended for education institutions to maintain a system in place and establish ways to consult students and hear their voice and then explore their views as learners and document the nature and quality of their experiences (ACPA & NASPA, 2004). One of the main factors in student engagement is gauged through student attendance, though, this is a poorly defined measure as it only takes a narrow view of student participation. Therefore, this study did not consider traditional engagement measures such as mere participation in class and attendance and instead looked at engagement as a comprehensive measure in different ways as seen through the students' lens (further details are given in data and methodology section).

Drawing on Bloom (1956), Fredricks, Blumenfeld, & Paris, 2004, identified three dimensions of student engagement, which are emotional, behavioural, and cognitive. A review of the literature shows that these dimensions are associated with different concepts. Behavioural engagement is defined as attendance, participation in learning and activities and interaction with others. Emotional engagement is considered as a

sense of belonging, attitudes, interests, and values during the learning process. Cognitive engagement is defined in terms of motivation, persistence and deep processing of information during the learning journey.

Most other studies have found a positive association between student attendance and their performance in studies (Durden & Ellis, 1995; Gatherer & Manning, 1998; Grabe & Christopherson, 2008; Massingham & Herrington, 2006; Stewart, Stott, & Nuttall, 2011; Thatcher, Fridjhon, & Cockcroft, 2007). As a response to the pandemic and the move to online learning, student engagement became even more challenging, and was considered a sector-wide concern for universities (Nickerson and Shea, 2020). However, there is almost non-existent research, exploring the link between student engagement and their performance during the COVID-19. Some researchers looked at the different strategies to foster student engagement (descriptive studies) as a result of pandemic challenge (Zhang et al., 2021; Brown, 2021; Lungu and Lungu, 2021, Koob et al., 2021). To the best of our knowledge, this is the first empirical study looking at an empirical relationship of student online engagement and end-of-term exam performance in an economics module (Level 6) in an international education setting in England, during COVID-19.

4. Analysis

4.1. Model: Education Production Function (EPF)

This study used the Education Production Function (EPF) to describe the quantitative relationship between education inputs and output adopted from Harris (2010). The EPF is derived from production theory in Economics and is defined as a process where a combination of all education inputs (student, school, teacher etc) produce a certain level of output such as students' test score/academic achievement. This methodology is commonly used in estimating the effect of any education input on education output. A contemporaneous specification, which assumes observed performance of students are determined by only current inputs.

The equation for above EPF is written as:

$$Y_{it}^{\text{Student performance}} = \beta_0 + \beta_1 X_{it}^{\text{Student gender}} + \beta_2 \text{Student Engagement1} X_{it}^{\text{Attendance Live}} + \beta_3 \text{Student Engagement2} X_{it}^{\text{Avg formative score}} + \beta_4 \text{Student Engagement3} X_{it}^{\text{Discussion board}} + \beta_5 \text{Student Engagement4} X_{it}^{\text{Student motivation}} + \epsilon_i$$

Where:

$i = 1 \dots n$ denotes the student.

$Y_i^{\text{Student Performance}}$ – Student performance measured as end-of-term exam score in Microeconomics, term 2.

X_i^{Student} – Students demographic variables: Gender measured in term2.

Student Engagement X_{it} . Student Engagement is measured as their self-perceived and self-reported behaviour in term 2 related to excitement, involvement, and participation (these questions are measured on five point Likert scales) in classroom in term 2, along with other engagement indicators, such as, attendance in live teaching sessions, average formative assessment score, use of online discussion board.

ϵ_i – Error term assumed distributed as normal.

$\beta_0, \beta_1, \beta_1, \beta_2, \beta_3, \beta_4, \beta_5$ are parameters and are estimated through using Multiple Regression technique in STATA (Software for Statistics and Data Science). Figure 1 below explains different dimensions of student engagement used in this study.

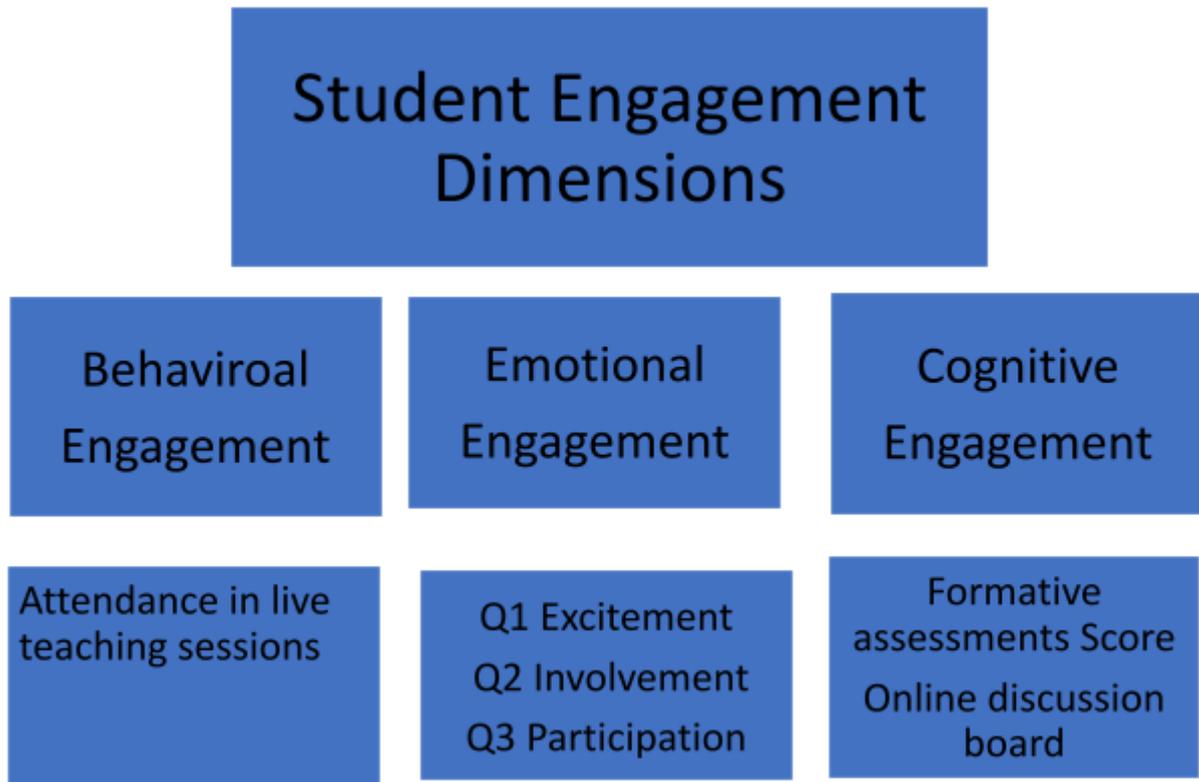


Figure 1: Student Engagement Dimensions

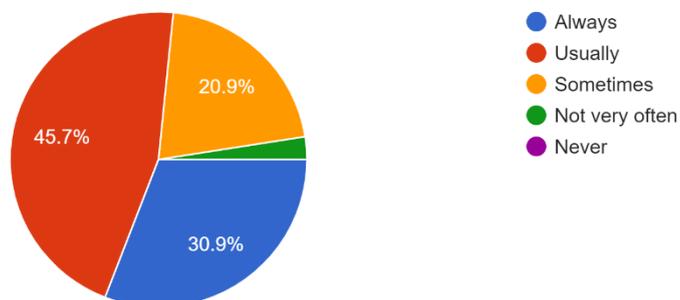
The current study presents an analysis of the association between a range of student engagements during an online course and end-of-term performance measured as marks obtained in end-of-term summative assessment in an economics module.

1. Percentage of attendance in classes (including lecture and seminars).
2. Engagement with formative assessment measured as average marks obtained in four online class progress tests.
3. Use of an online academic discussion board during the term.
4. Students' own perceptions/beliefs of their engagement during online classes measured as a composite index consist of an average of three sets of items (Q1 excitement, Q2 involvement, Q3 participation). These questions were asked to students in an online survey and their responses were recorded on a 5 point Likert scale.

The students' engagement was measured as their perceptions related to excitement and participation in online classes asked in mid-term students' questionnaires. For further details, see Figure 2, below showing responses to the questions re student engagement.

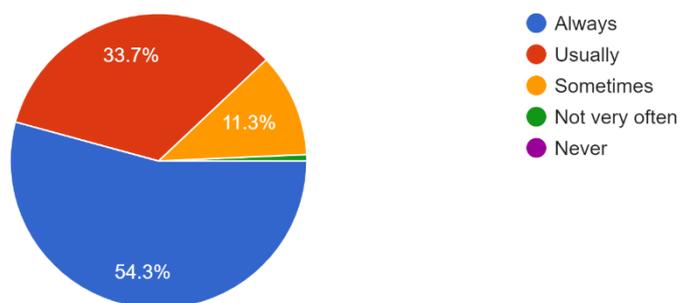
7) How excited are you about going to your classes?

282 responses



8) How often do you get involved in activities in your classes?

282 responses



9) In class how eager are you to participate?

282 responses

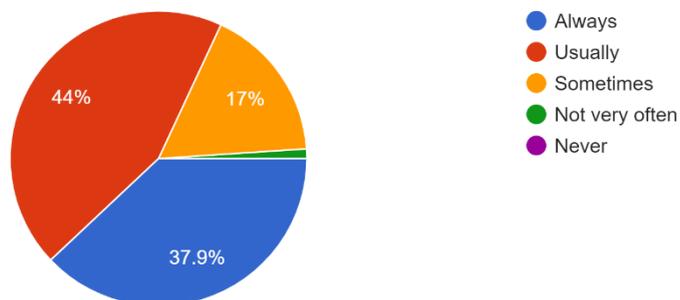


Figure 2: Student responses to questions re engagement

5. Results and Discussion

Table 3 (Appendix 2) presents the operational definition of variables and a descriptive summary of the estimated effect of a range of student engagement variables (independent variables) on student performance in the economics exam (dependent variable). A multiple regression model (Table 4 in Appendix 2) was used to estimate the relationship between student engagement and performance. In order to find the coefficient estimates of variables, STATA was used to run the model.

Before estimation of the model, the data were cleaned for missing information. Student id information was missing for 100 students, reducing our sample for 282 to 172, because of that the author was unable to match those questionnaires to administrative data of test scores. Due to a few other missing information on self-reported variables (student motivation level, the final estimated sample size arrived at 172 observations (students). It is crucial to estimate the model using consistent observations of all variables, so that our results are not affected by any sample change and the estimated coefficients are robust.

The variables such as gender, attendance in live teaching sessions and student motivation appeared as insignificant whereas formative assessment score and use of online discussion board turned out as highly significant (significant 1% level of significance). This means that neither of those variables (gender, attendance in live teaching sessions and student motivation) have any statistical relationship with student performance in end-of-term exams in this model. Therefore, it is irrelevant to discuss the effect of coefficients of these variables on outcome variable.

However, there are a few things worth mentioning about statistically insignificant variables. Firstly, attendance during live teaching sessions has an external restriction imposed on it. Students are mandated to attend classes if they will have visa issues, the distribution of the attendance variable is skewed towards maintaining the requirement. Therefore, all students will have at least the minimum attendance. Those that have high marks and low marks will have high attendance (The mean attendance is 96% in our sample which is quite high and confirming the compliance of visa policy). This reduces the predictive power of attendance. So, the external restriction on attendance is confounding the results. Our insignificant results of attendance variable are contrary to studies in the past (Grabe & Christopherson, 2008; Massingham & Herrington, 2006; Stewart, Stott, & Nuttall, 2011).

Secondly, the negative coefficient on student motivation (although statistically insignificant) seems counter intuitive, as one could expect a positive association between student motivation and end-of-term performance. This could be due to the fact that these students are highly motivated (self-reported), but they may not know how to use appropriate learning strategies, hence ending up spending more time during classes. This suggests that they are doing hard work, but it does not translate into results. Classroom evidence shows that students do not always know how to use online resources effectively and efficiently. Another reason of negative coefficient for the student motivation variable could be measurement error as a result of self-reported bias, which is ubiquitous in survey data where cognitive processes, social desirability, and survey conditions can alter interviewee's responses (Bound, Brown, & Mathiowetz, 2001).

Turning to statistically significant coefficients, the coefficient on formative assessment score represents the mean increase of total marks obtained in the economics module for every additional one mark in the formative score, keeping all other factors constant. This implies that if the formative assessment score increases by 1, the average total marks in the economics subject increases by 0.42. Similarly, the coefficient on use of online discussion boards has a positive value means that a student increase in use of weekly discussion boards will increase student marks in the economics by 0.52, keeping all other factors constant. Our results corroborate previous findings (Appleton et al., 2008; Fredricks and McColsky, 2012).

6. Conclusions and Policy Implications

The current study was conducted to fill a gap in existing literature on student engagement and performance using a unique student survey data matched with administrative data. It was unique in its nature of measuring an association between student engagement and their education outcome in England in the Sheffield

International College setting. Multiple regression analysis was conducted to investigate the relationship between student engagement and their end of term performance. The findings show a positive and significant relationship between online engagement (performance in formative assessments and use of discussion board) and performance (end-of-term score). To sum up, this study also provides useful insights by informing as to what works best for students regarding their engagement.

These results have several implications. With the efficient and effective use of online discussion boards, student engagement can be enhanced and that increases the student education outcomes. This has obvious implications for HE, contributing to local, institution and sector-wide debate on student engagement and performance. This policy is easy to follow as almost all universities are using VLE for learning and teaching and using online discussion boards has no extra cost for education providers. Another implication is that educators can use formative assessments as a tool effectively to increase student engagement, leading to a positive effect on student performance. However, these call for further insights that a careful and thorough design of formative assessments is needed. It is also important while designing the formative assessment, to make sure that planning goes into developing a clear link between formative and summative assessments so that the results from formative assessment can be translated to summative assessments. The findings of the paper show a positive and significant relationship between online engagement (performance in formative assessments and use of discussion board) and performance (end-of-term score). This study also provides useful insights by informing as to what works best for students regarding their engagement.

6.1. Limitations of the Study

Despite the above study presenting an evidence-informed approach of student engagement and performance, nonetheless, there are few caveats.

1. Analysis of the study is based on cross-section data (that is, data collected at one point of time)-data analysed precluded any definitive claims of causality.
2. This study does not use a modified value-added education production function, this important because it takes into account the effect of student past performance. This is very important to control the prior ability of students in the previous term as it captures the effect of previous knowledge and understanding gained through prior studies/work experience, it is also an indicator of prior achievements that students bring into the classroom.
3. It is possible that high performing students are those who have higher motivation, which is impossible to capture completely.

Future research with longitudinal methods could be used to address the issue of causality. Further, we would be cautious before generalising the findings to other parts of the UK, or indeed to other countries.

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Appendix 1

Student Questionnaire

- 1) Teaching group -----
- 2) What is your major area of study? Business Economics
- 3) Gender: I prefer to define myself
 Male
 Female
 I prefer not to say
- 4) What are the BEST ASPECTS of how your college engages students in learning?
(You can pick more than one options but not all)

Lecture
Seminars
Progress tests
Online discussion board
In class activities
Mole video/materials
Or any other -----
- 5) From above Question 4, Why you think they are the best (provide reason/justification)

- 6) What could be done to IMPROVE how your college engages students?

- 7) How excited are you about going to your classes?

Always Usually Sometimes Not very often Never
- 8) How often do you get so focused on activities in your classes that you lose track of time?

Always Usually Sometimes Not very often Never
- 9) In your classes, how eager are you to participate?

Always Usually Sometimes Not very often Never
- 10) Which aspects of class have you found most engaging?

- 11) Which aspects of class have you found least engaging?

12) If you were teaching class, what is the one thing you would do to make it more engaging for all students?

13) How do you know when you are feeling engaged in class?

14) What projects/assignments/activities do you find most engaging in this class?

15) What does this teacher do to make this class engaging?

16) Any other comments -----

Appendix 2

Table 3. Operational definition of variables and descriptive summary

Definition of Variables used in present study	Variables	Observations	Mean	Standard deviation	Min	Max
Dependent variable 1						
End-of-term student performance measured as marks obtained in summative assessment of Economics course	Student performance	172	67.42	14.22	0	91
Independent variables						
Gender dummy variable 1= Male 2= Female	Gender	172	1.47	0.50	1	2
Indicators of engagement						
Engagement 1: Attendance in live teaching sessions (including lectures and seminars)	Attendance in live teaching sessions	172	96.40	13.76	0	100
Engagement 2: Score in formative assessment (online class test)	Formative assessment score	172	73.92	15.62	10	99
Engagement 3: Student use of online discussion board during the term	Use of Online discussion board	172	6.19	4.19	0	11
Engagement 4: Student self-perceptions	Student motivation	172	2.49	1.07	1	4
Sample Size	N		172			

Table 4. Regression Analysis: Determinants of Performance

Dependent variable is student score (Total marks obtained in Economics module)

Variables	Coefficients	Robust Standard Errors in parenthesis	t value	p-value
Gender	0.41	(1.82)	0.23	0.82
Attendance in live teaching sessions	0.03	(0.052)	0.61	0.54
Formative assessment score	0.42***	(0.099)	4.29	0.000
Use of Online discussion board	0.52***	(0.220)	2.35	0.020
Student motivation	-1.01	0.830	-1.22	0.224
Constant	31.607			
N	172			
R ²	0.27			
F-value	6.63			
Prob >F	0.000			

Notes: *** p<0.01, ** p<0.05, * p<0.1. (.) report robust standard errors