Is it Worth Attending Classes in-person? A Post-COVID Study in ICT University Courses

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Keywords: Higher education · Curriculum design · Learning environment · Teaching quality

1 Introduction

The rate of physical, in-person attendance of university courses has sharply dropped[1] since the return to pre-COVID times. This attendance behaviour has not only been noticed at our own institution, but also acknowledged by colleagues from other institutions as well [1].

This is a particularly interesting observation in Information and Communication Technology (ICT) programmes such as Computer Science, Information Technology, Software Engineering, Information Systems, etc. because many students have decided to try the self-learning approach via Massive Open Online Courses (MOOCs). Indeed, MOOCs are an excellent option for self-learning [4] and allow students to acquire very valuable ICT knowledge without the need to complete a full University programme.

This situation has led us to speculate what factors students may weigh in to determine whether it is worth attending a course in-person. Among these factors, we believe that the most representative ones are: (1) the grading criteria, since it is what determines what the student has to reach to pass the course; (2) the assessment method, since it is what determines how the student will be tested to define whether they have acquired the intended learning outcomes – ILOs; and (3) the teaching methodology, since it is what determines how students learn and get trained towards the ILOs.

The obvious question that arises in this context is the following: *Does class in-person attendance have an impact on the student's performance?* Or putting the question in a measurable form: *Is there any correlation between attendance rates and the achieved grades for a given course?*

Knowing whether there exists a correlation or not it is not only important to the instructor leading the course, but also to study programme directors (often

[1] Assuming that course attendance is not compulsory, which is the case for many academic institutions in Europe and the US.

in charge of the design and maintenance of the programme's curricula), teaching quality officers, or any other curricula decision maker.

For many instructors, attendance rate is a key performance indicator (KPI) about the effectiveness of their teaching method and pedagogical quality. Moreover, being able to seek a trade-off between attendance rate and failure/success rate may also be used as a KPI to assess how the course is designed and delivered.

The same KPIs may be used for course directors to monitor the quality of the study programme's courses. It is of particular interest to detect courses with low in-person attendance rates and low failure rates, since this may be a signal that either students are not acquiring the ILOs as expected, or the course settings would make it a good candidate to be switched to online or hybrid mode, thereby releasing valuable but scarce resources like physical classrooms or teaching assistants.

Knowing the correlation between attendance rates and grades of a course may also be helpful for prospective students: they can be warned in advance about the importance of attending the course sessions in order to successfully pass it. For students who need to decide which course to follow in-person (e.g. among a certain available course offer), knowing these KPIs in advance may help them to make a more informed decision.

1.1 Contributions

The main objective of our work is to offer a general methodology that will assist education specialists to determine whether in-person course attendance has a positive or negative impact on the academic performance of students following a given course. We should note that our methodology is applicable to courses where the instructor and the students are working synchronously; i.e., at the same time but not necessarily in the same place. However, for simplicity's sake we will focus on the physical setting, where both the instructor and the students share a common space and time.

We hypothesised that *in-person attendance enhances student's performance* due to the possibility to acquire knowledge and develop and train their skills in a dynamic and alive learning environment, as regular university classes are supposed to be. A pilot study (see Appendix A) gave us preliminary evidence to validate this hypothesis and also helped us to layout the proposed methodology which will hopefully serve as a tool to evaluate the quality of a course or even an entire curricula. Therefore, the main stakeholder in our work is a study director rather than course instructors or students.

2 Experimental Setup

Previous experience in manual control of room occupancy has shown poor results. For example, attendance lists expected to be completed by the instructors were never returned, or if they were, the provided information was not accurate. Therefore, an automatic attendance control mechanism is required to get accurate information. For this, a Learning Management System (LMS) such as Moodle, Sakai, Acorn, etc. seems to be the most sensible option, because an LMS will generate access logs with timestamp information that can be used to filter the data according to the scheduled course time hours.

This method for checking attendance is based on the way we use the LMS at our institution to deliver most of our courses. During each session we make use of resources that are accessible through the LMS course page, such as quizzes, readings, videos, etc. These resources are made available to students either during or just before starting the session, to avoid students looking at them in advance, unless explicitly required. Therefore, students are required to connect to the LMS during the time the course is being delivered.

We should point out a couple of important assumptions in the proposed method: (1) it is unlikely that a student who is attending the course in-person would share information with a classmate who is away during the session's time window; and (2) a student who is away but has anyhow successfully connected to the LMS during the course's scheduled time is considered as a valid attendance (i.e., the student has made the effort to see what's going on at the course as if they were physically present, although this situation will happen very infrequently).

Armed with this way of automatically checking course attendance in a transparent way, we are in a good position to correlate attendance rate and academic performance. **Course attendance rate** is defined as the number of physical attendance of students to each scheduled session of a given course, out of the total number of the scheduled course sessions. **Academic performance** of a given student is defined as the final grade they get after course completion.

We recommend to use a mixed-methods sequential explanatory experiment[2] to complement the collected quantitative data with qualitative data from students and instructors via surveys, in order to collect additional evidence. For example, students can report their (subjective) attendance rate and we can compare it against the collected data to see if there are discrepancies. If so, the course can be tabled for an in-depth analysis e.g. by interviewing the instructor.

2.1 Design Variables

Our independent variable is $a_j^i \in \mathcal{A}$, or the attendance rate of student j in course i. Our dependent variable is $g_j^i \in \mathcal{G}$, or the grade achieved by student j in course i. We also propose two optional modifiers of the dependent and independent variables that make it possible to filter out the collected data:

- $\tau_a \in [0, 1]$: cutoff threshold to determine if an attendance rate is low or high. For example, $\tau_a = 0.2$ means less than 20% of all course sessions attended.
- $\tau_g \in [0, 1]$: cutoff threshold to determine if a grade is low or high. For example, $\tau_g = 0.5$ represents half of the grade required to pass the course.[2]

[2] If a course uses a grading scale from 0 to 20, then $\tau_g = 0.5$ means that failing students are those who scored less than 10 points.

2.2 Research Hypotheses

Assuming $\mathcal{A}$ and $\mathcal{G}$ are random variables, we define:

- Null hypothesis H_0: $\rho(a_j^i < \tau_a,\, g_j^i < \tau_g) \approx 0$.
- Alternative hypothesis H_a: $\rho(a_j^i < \tau_a,\, g_j^i < \tau_g) \neq 0$.

with

$$\rho(\mathcal{A}, \mathcal{G}) = \frac{\mathbb{E}\left[(\mathcal{A} - \mu_{\mathcal{A}})(\mathcal{G} - \mu_{\mathcal{A}})\right]}{\sigma_{\mathcal{A}} \sigma_{\mathcal{G}}} \tag{1}$$

where $\sigma_{\mathcal{A}}$ is the standard deviation of the attendance rates, $\sigma_{\mathcal{G}}$ is the standard deviation of the grades, and $\mathbb{E}[\cdot]$ is the expected value of a random variable with finitely many outcomes.

The simplest scenario is where $\tau_a = \tau_g = 0$; i.e., where all attendance rates and all grades are considered for analysis. Then, depending on the desired use case scenario, the experimenter may want to compute the correlation between both variables under more specific conditions. For example: Do low attendance rates (using e.g. $\tau_a = 0.2$) correlate with failure (using e.g. $\tau_g = 0.5$)?

3 Planned Study

We plan to apply our method in courses belonging to our institution's Bachelor programme in Computer Science [3] (BiCS), delivered during the winter semester. The curriculum for the academic year 2022–2023 determines that there are 6 courses in Year 1, 5 courses in Year 2 and 5 courses in Year 3. This makes a total of 16 courses for which we need to collect their attendance rate using the method described above. Besides all the students to be surveyed, there are also 40 instructors who will be consulted too. Appendix B shows the distribution of instructors for each course to be sampled from the BiCS programme.

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[3] `https://bics.uni.lu`

A Pilot Study

We ran an experiment in a web development course offered to last-year bachelor students in Computer Science. The course has weekly lectures and practical sessions. Course attendance is not mandatory but it is offered in physical form only, according to the regulations of our institution.[4] The course has continuous evaluation through weekly coding assignments that students must complete on their own. Each coding assignment is assessed on a 0–10 grading scale.

The course instructor registered the name of the students who attended the practical session at week 3 (i.e. 3 weeks after the course started) using pen and paper. Then we analysed the data in order to validate or reject our hypothesis that in-person course attendance is beneficial to support students' learning.

Figure 1 shows the distribution of grades achieved by the students in the previous coding assignment, which was graded at week 2. Using $\tau_a = 0$ (since we measured attendance in only one session) and $\tau_g = 0.5$ as a cutoff threshold for passing the course, we can clearly identify two groups of students. Twenty-nine failing students scored less than 5 points, whereas thirty-one students scored 5 points or higher.

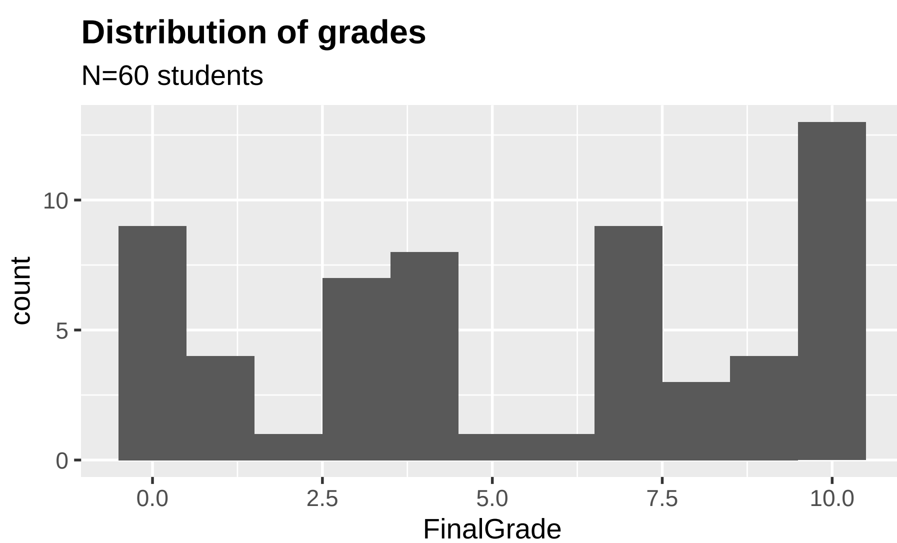

Fig. 1. Histogram plot with the overall distribution of grades.

We used a one-tailed t-test to analyse if there were a statistically significant difference between grades attained by students who attended the week 3 session in-person and by students who did not attend in-person. Indeed, the difference

[4] See `https://wwwfr.uni.lu/coronavirus/guidelines#Teaching`.

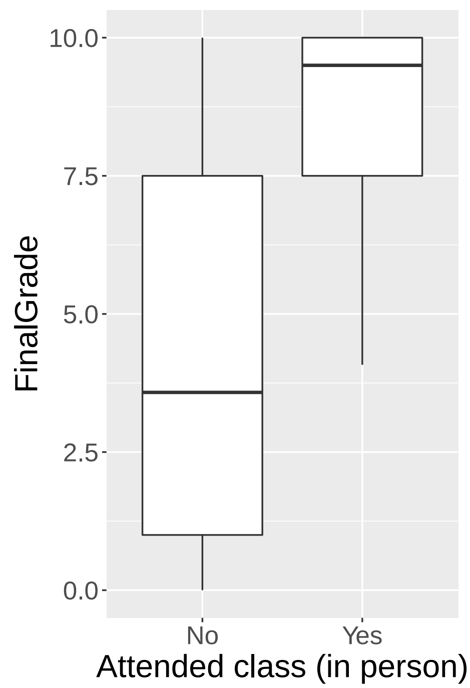

Fig. 2. Boxplot of grades distribution split by in-person attendance.

is statistically significant: $t(48) = 4.406, p < .0001, d = 1.313$. The effect size (Cohen's d) suggests a large importance of the results. We then computed the Pearson's product-moment correlation to see whether grades and attendance are correlated. Indeed, there is a true correlation: $\rho = 0.5$ ($p < .0001$) and it is considered a strong one in behavioural sciences [3].

Finally, as an additional exercise, we computed the likelihood of passing a coding assignment given in-person attendance. Denoting $\Pr(\text{Passing}) = \Pr(g_j^i \geq 5)$ and "Attended" as "having attended the last practical session in-person", then we computed $\Pr(\text{Passing}|\text{Attended}) = 0.933$ and $\Pr(\text{Passing}|\neg\text{Attended}) = 0.377$. In sum, the likelihood of passing the coding assignments in that course is much higher if students attend classes in-person.

We should note that this study is merely anecdotal because it has been tested on a particular cohort of students belonging to a particular ICT-related course. Further, the study was conducted at a particular point in time. Therefore, more research is needed to replicate our proposed methodology with more courses and at a larger scale.

B Courses and Instructors distribution

Table 1. Distribution of instructors by courses.

Course name	**No. Instructors**
Year 1 - Winter semester	
Linear Algebra 1	3
Analysis 1	4
Discrete Mathematics 1	3
Programming Fundamentals 1	3
Web Development 1	2
Bachelor Semester Project 1	3
Year 2 - Winter semester	
Discrete Mathematics 2	2
Programming Fundamentals 3	2
Algorithms and Complexity	2
Information Management 1	2
Security 1	3
Year 3 - Winter semester	
Software Engineering 1	1
Human-Computer Interaction	6
Computational Science 2	1
Web Development 2	2
Natural Language Processing	1