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Comparing Online and Face-to-Face Mathematics Examination Results of Students in a Particular University in South Africa: A Case Study.

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Abstract

The study compares the online and face-to-face Mathematics examination results of students in a particular university in a South African higher Learning Institution. Literature was reviewed to establish what is being said about online as compared to face-to-face examinations. The examination results for Mathematics 1 and 2, both online and face-to-face, at a particular university in South Africa, were analyzed qualitatively and quantitatively and compared. The results analysed in Mathematics 2 were for the same students who passed Mathematics 1 and proceeded to Mathematics 2. Both Mathematics 1 and Mathematics 2 had online and face-to-face tests. There was a discrepancy between the online and the face-to-face results. Mathematics 1 had 1994 students enrolled and had a pass rate of 93% out of 1030 who wrote the examination, and a success rate of 48%. Mathematics 2, which had 2283 students enrolled, had a pass rate of 77 % out of 1550 who wrote the examination and a success rate of 53%. For both modules, the online component was far better as compared to the face-to-face component. The results made the university very careful when it comes to online tests or examinations. Only proctored online tests or examinations should be given.

Keywords: examination results, face-to-face, online results.

Introduction

Ever since COVID-19, many learning institutions have resorted to blended learning, where some teaching and learning, as well as assessments, are done online. At first, this approach was a problem for both lecturers and students because no one was prepared for that, but the circumstances forced the situation. Some lecturers needed some training to be able to give lessons and examinations online. Students also needed some training to do everything online. Some universities did not have the necessary equipment for online teaching and examinations. In this paper, online and face-to-face Mathematics 1 and 2 examination results are compared.

Literature Review

Literature has shown that online and face-to-face examinations have some advantages and disadvantages. For example, the benefits found by Buchanan (2000) & Hewson, Charlton & Brosnan (2007) are that online assessments are cost and time-saving because of automated delivery, scoring, and storing of responses; immediate feedback, promote high levels of student engagement, allowing students to be able to submit an assessment or assignment remotely without coming into college. Online assessments also save costs for the institutions from writing material, paying invigilators, and printing of assessments.

However, according to Muzaffar, Tahir, Anwar, Chaudry, Mir & Rasheed (2021), online examinations compromise the integrity, security, and examination objective. Issues of integrity and reliability have always emerged both nationally and internationally when it comes to online assessments. For example, when it comes to reliability, Hewson *et al.* (2007) & Warburton (2009) took into consideration the potential for server crashes, as well as local hardware and software failures, which would normally not be present with traditional offline approaches. Hewson *et al.* (2007), Dennick & Purcell (2009), and Whitelock (2009) also worried about the validity when it comes to online assessments on whether they were able to provide a fair and accurate measure of what is intended, that is, in this context, as well as course-related learning outcomes.

Goldberg and Pedulla (2002) found that having a limited amount of time in which to complete the examination had more of a negative impact on performance in the computerized delivery modes than the pen and paper mode, concluding that it is important when implementing computer-delivered assessments to consider whether more time may be needed than for traditional pen and paper modes. However, Kotwal, Bhadke, Gunjal, & Biswas (2016) stated that some disadvantages of face-to-face examinations include delays in result processing, filing poses a problem, filtering of records is difficult, the chance of loss of records is high, also record searching is also difficult, maintenance of the system is also very difficult and takes a lot of time and effort.

The purpose of this paper is to compare online and face-to-face examination results. Under normal circumstances, if an examination has been given to

students, the results should show a normal distribution curve. There are students who obtain very low marks, those who achieve low marks, average marks, high marks, and very few who get very high marks. It has been observed that in a particular university in South Africa, whenever mathematics students are given tests, results obtained when tests are done online are always better than those obtained when it is a face-to-face test where invigilation is taking place. Therefore, the authors decided to compare the online and face-to-face students' examination results to check if the type of results obtained is genuine for both situations. This led to the following research question: *Are online and face-to-face examination results always comparable?*

The layout of the paper is as follows: the first part of the paper concentrates on the background, illuminating the challenges associated with both online and face-to-face examinations. In the second part, the literature review, more information on online and face-to-face examinations is given. The third part explains the research design and methodology. In the fourth section, data are analyzed and discussed. Examples of online and face-to-face examination results are given and analyzed. Finally, conclusions are then given.

Methodology

The study followed a mixed-method approach. Data was analyzed both qualitatively and quantitatively.

Data Collection

Online and face-to-face Mathematics 1 and Mathematics 2 students' examination marks for 2024 were compared. The results were for the same students who had written Mathematics 1 in the first semester and then proceeded to Mathematics 2 in the second semester. This was done to compare the results for the same students' examination results done online and those done face-to-face.

Data Analysis

The comparison was done to check whether the pass rates for online and face-to-face results were comparable. Literature was also viewed based on the challenges associated with online and face-to-face examinations. The researchers were aware that even if they used results for the whole group of Mathematics 1 and 2, the results might not be generalised because only one institution was used.

Results and Discussion

Below are the semester 1 tests' distribution marks for Mathematics 1 and 2 for the year 2024 for a particular university.

Mathematics 1 marks Semester 1

Table 1: Mathematics 1 tests

Grade Distribution	Test 1 (face-to-face)	Test 2(face-to- face)	Test 3 (online)
90-100	34	38	59
80-89	71	112	438
70-79	121	181	243
60-69	219	227	331
50-59	317	244	177
40-49	283	413	314
30-39	339	184	107
20-29	316	208	44
10-19	106	171	4
0-9	0	0	0
Total wrote	1806	1778	1717
Pass	762	802	1248
% pass	42	45	73

The above table shows the results of the students who enrolled to do Mathematics 1 in the first semester of 2024. According to the grade distributions, test 1 and test 2 were face-to-face, where invigilation took place. Test 3 was conducted online, where there was no invigilation. According to the grade distributions, it can be observed that students performed poorly on face-to-face tests as compared to the online non-investigated test 3. 1806 students wrote the first test, and 762 students passed, which gave a pass rate of 42%. The second test was written by 1778 students, and 802 students passed, which gave a 45% pass. The third test was online, where no invigilation took place. Of the 1717 students who wrote, 1248 students passed, which gave a pass rate of 73%. The weights for the 3 tests were 30:40:30, respectively. The average term marks for students were calculated according to the weights, and the results are shown in Table 2 below.

Table 2: Average marks for the 3 tests

Grade Distribution	Average marks
90-100	20
80-89	29
70-79	134
60-69	303
50-59	524
0-49	911
Total wrote	1941
Qualified for Exam	1030
% pass	53

Table 2 above shows the distribution of the average semester marks that students got before writing the final examinations. 1941 students wrote the tests. After calculating the average mark, 1030 students passed, which gave a pass rate of 53 %. The students who managed to get an average of 50% and above proceeded to write the final examination, as shown in Table 3. Those who got less than 50 % failed the module.

Table 3: Mathematics 1 Face-to-Face Examination Mark Distribution

Grade Distribution	Examination marks
90-100	12
80-89	50
70-79	124
60-69	257
50-59	406
40-49	125
30-39	50
20-29	6
10-19	0
0-9	0
Enrolled	1994
Total wrote	1030
Pass	849
% pass	82
Success rate	43

The above Table 3 shows the 1030 students who managed to pass the tests and proceeded to write the final examination. Of the 1030 students who wrote the examination, 849 students passed. This gave a pass rate of 82 % $\left(\frac{849}{1030} \times 100\right)$ which was a good pass percentage, and a success rate of 43% $\left(\frac{849}{1994} \times 100\right)$. The overall marks for the semester are given in Table 4.

Table 4: Mathematics 1 Online and Face-to-Face Overall Module Results

Module	Year: 2024	Enrolled	Wrote	Passed	Overall Pass Rate	Success Rate
Mathematics 1	Semester 1	1994	1030	960	93 %	48 %

The above table shows the overall marks for the module. This combines the mark for the tests (semester mark) and the final examination. The total number of students who were enrolled in the course was 1994. Of those, only 1030 students qualified to write the final examination. 960 (849+111) students passed, which

gave a pass rate of 93% and a success rate of 48%. The 111 students are within the (40-49) bracket whose average of the exam mark and the semester mark was 50% and above. The semester and the examination marks weighed 60:40, respectively. The students who passed mathematics 1 in the first semester proceeded to mathematics 2 in the second semester. The results for Mathematics 2 tests are shown in the tables below.

Mathematics 2 marks

Semester 2

Table 5: Mathematics 2 tests

Grade Distribution	Test 1 (face-to-face)	Test 2 (face-to-face)	Test 3 (online)
90-100	143	152	734
80-89	139	258	581
70-79	186	176	452
60-69	265	206	236
50-59	367	280	101
40-49	254	288	87
30-39	246	432	22
20-29	370	247	8
10-19	213	94	12
0-9	0	0	0
Total wrote	2183	2133	2233
Pass	1100	1072	2064
% pass	50	50	92

Same as in mathematics 1, mathematics 2 students were also given 3 tests, 2 face-to-face and the third one online. The same students who passed mathematics 1 enrolled for mathematics 2 and were combined with the larger group that had failed mathematics 2 the previous year. The same pattern for better online results was also observed for Mathematics 2. Of the 2183 students who wrote test 1, 1100 passed, which gave a pass rate of 50%. For test 2, 2133 students wrote, and 1072 passed, with a pass rate of 50 %. The third test, which was online, 2233 students wrote, and the pass percentage was 92. The average mark was obtained the same way as for Mathematics 1, whereby the weights 30:40:30 for the 3 tests were used to calculate the average mark. The table below shows the distribution of the average marks for the 3 tests for Mathematics 2

Table 6: Average marks distribution for mathematics 2 tests

Grade Distribution	Average marks
90-100	95
80-89	161
70-79	247
60-69	417
50-59	630
0-49	687
Total wrote	2237
Qualified for Exam	1550
% pass	69

Of the 2234 students who wrote the tests, 1550, which was 69% pass rate managed to proceed to write the examination, as shown in Table 7, whereas the rest failed the module.

Table 7: Mathematics 2 Face-to-Face Examination Mark Distribution

Grade Distribution	Examination marks
90-100	14
80-89	71
70-79	164
60-69	298
50-59	449
40-49	445
30-39	90
20-29	8
10-19	7
0-9	4
Enrolled	2283
Total wrote	1550
Pass	996
% pass	64
Success rate %	44

The examination for mathematics 2 same as for mathematics 1 was also face-to-face. 1550 who had an average of 50 % or above in the tests wrote the examination. 996 students managed to pass, and the pass rate was 64% with the success rate of 44 %. The final results for the module for Mathematics 2 are then shown in Table 8.

Table 8: Mathematics 2 Online and Face-to-Face Overall Module Results

Module	Year: 2024	Enrolled	Wrote	Passed	Overall Pass Rate	Success Rate
Mathematics 2	Semester 2	2283	1550	1199	77%	53%

The above table shows the overall results for the mathematics 2 module. Of the 2283 students enrolled for the course, 1550 students qualified to write the examination. 1199 students passed, and the overall pass rate was 77% and the success rate was 53%. Same as in Mathematics 1, the weights for the semester mark and the examination were 60:40, respectively, to make a final mark for the module to be out of 100.

From Table 1, Mathematics 1 tests students performed poorly for the 2 face-to-face tests and did very well for the online test. Similarly, from Table 5, which is for Mathematics 2 tests, the face-to-face tests were not that good that even though the pass rate was 50 % for both tests 1 and 2, but the online test was well done. It can be observed that the ranges 80-89 and 90-100 for the online tests had a very large number of students, which does not normally happen if it is a face-to-face examination. That can be witnessed in Tables 1 and 5, and Tables 3 and 7 for the mathematics 1 and 2 examination mark distributions, respectively. The pass percentages for both mathematics 1 and 2 online tests were very good, and that helped a lot of students who had not performed well in face-to-face tests for both mathematics 1 and mathematics 2 to qualify for the final examination. Had it not been the online tests, the pass rates for both modules would have been very bad.

From Tables 3 and 7 for mathematics 1 and mathematics 2 examination results, respectively, the pass rates are good, both above 50 %. The same applies to the final overall module results, Tables 4 and 8. This might be because all students who had qualified to write the examination worked extra hard to pass. However, for both mathematics 1 and 2 examination and module results, the success rates were very low, as indicated in Tables 3 and 4 for mathematics 1 and Tables 7 and 8 for mathematics 2. Below are the reasons that could have led to the low success rates for both Mathematics 1 and 2:

- In mathematics 1, since some students were still from high school, not used to studying, they did not prepare thoroughly for the tests.
- Some students from high school struggled to adjust from high school to tertiary mathematics content.
- Considering that the students who passed mathematics 1 are the same students who proceeded to mathematics 2, some students who did not pass mathematics 1 very well struggled in mathematics 2, with a change in content from one level to a higher mathematics level.
- A lot of students did not qualify to write the examination even if they had registered for the module, and therefore, they automatically failed.
- Some students got too low marks for face-to-face tests, even when they passed the online test, which could not help them.

The reasons for the online tests to have high pass rates could be attributed to:

- The online tests had a multiple-choice component, while the face-to-face one did not have that component.
- It could be that since students were writing from wherever they wanted, not being invigilated, they could have been working in groups helping each other, hiring some other people to write for them, or using some other platforms to share the tests, just to mention a few reasons, since the examinations were not proctored.

This agrees with Harmon & Lambrinos (2007), who found that cheating was taking place when the examinations were not proctored. This also agrees with the study carried out by Ardid, Gómez-Tejedor, Meseguer-Dueñas, Riera J, and Vidaurre (2015), which concluded that results obtained in the un-proctored environment present a bias towards higher ratings, as well as a greater dispersion of results regarding the case of the proctored environment.

Conclusion and Recommendations

The results obtained show that students got better results in online tests as compared to face-to-face examinations. According to the results obtained, it can also be concluded that face-to-face examinations give a true reflection of students' performance as compared to online examinations, and the objectives of the examination are achieved better in a face-to-face examination where invigilation is taking place. This study agrees with other researchers cited above who found that proctored examinations are better at avoiding undesirable results. Higher learning institutions should be very careful when giving assessments online. Only proctored online tests or examinations should be given.

A case study was used; only a small population was used. It is recommended that a bigger study with other departments within the same university be carried out so that the results can be generalized.

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