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Interaction Effects of Undergraduate Students' Factors and Two Instruction Modalities on Academic Performance in a STEM Course

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Abstract

Presently, schools are changing from a face-to-face (F2F) teaching mode to an online or virtual mode of teaching. Research has shown the two instruction modes to affect students' success positively. However, studies investigating the interaction effects of students' factors that could enhance the effectiveness of the two modes of instruction are limited. This study examines how age, socioeconomic status (SES), and course of study affect how well students do in both face-to-face and online settings.

The study employed an ex post facto design. The sample consisted of 620 third-year undergraduate students enrolled in a science, technology, engineering, and mathematics (STEM) education course. Students' assessment results and demographic data were utilized to collect data for the study. Data analysis using percentages, paired sample t-tests, and Analysis of Variance (ANOVA) showed that students' grade point average (GPA) ranked better when the F2F mode of instruction was adopted than in the online classroom. Also, there was an interaction effect of age, SES, and course of study on students' performance in the two modes of instruction. This paper discusses factors that can help students succeed in school, both online and in-person, so that instructors can assist students more effectively.

Keywords: Students factors, online, Face to Face, Students performance, STEM

INTRODUCTION

The COVID-19 pandemic escalated educational stakeholders' and researchers' "thinktank" discussions on how to facilitate online and face-to-face (F2F) modes of instruction to improve students' performance. Currently, only a few schools have adopted the online mode of teaching (Aldhafeeri & Alotaibi, 2022; Burtnaru et al., 2021; Darius, Gundabattini, & Solomon, 2021; Morin, Safaee, & Saadé, 2019; Yu, 2021), while others continue to use the face-to-face (F2F) approach (Hu-Au, & Okita, 2021). Classroom learning, generally known as the traditional, offline, or face-to-face approach to learning, involves the physical presence of teacher and student in a closed-wall classroom where teaching and learning occur. There is extant literature on the effectiveness of the face-to-face mode of instruction on student learning (Darius, Gundabattini, & Solomon, 2021; Nyumen, 2015) and engagement (Aldhafeeri, & Alotaibi, 2022). Over the years, F2F instructional strategies, techniques, and teaching methods have benefited students' learning outcomes (Bamidele & Adebusuyi, 2017; Bamidele, Adetunji, Awodele & Irinoye, 2013). However, despite its benefits to students' learning outcomes, the F2F classroom modality has been characterized as restrictive, inflexible, and impractical for some students (Paul & Jefferson, 2019). The disadvantages of the F2F classroom, especially during the pandemic, made online teaching prominent. Schools now provide effective classroom teaching via the web.

Online teaching and learning take place virtually, so the instructor and the learner do not need to see each other physically. Learning virtually means acquiring new knowledge, skills, behaviors, and preferences through online resources or instructors. It is an active process of engaging with and manipulating experiences to build mental models of the world (Paul &

Jefferson, 2019). Learners learn as they explore, observe, and interact with the world. Many online courses are now available due to research into online studies. However, the effectiveness of online learning may not be fully maximized as Helms (2014) argued that online students have acute learning curves, which may be due to their inability to adjust to new technological ways of carrying out instructions. Online modes of instruction, therefore, suffer some setbacks, among which are delayed feedback; network issues; lower motivation to read the bulk of online materials; and procrastination in learning, which eventually leads to students feeling isolated and frustrated (Ni, 2013; Paul & Jefferson, 2019). Thus, the F2F mode of instruction remains relevant as it can provide support to overcome some of these online modality obstacles. Paul and Jefferson (2019) say that one of the many benefits of F2F over online delivery is the flexibility of the classroom for delivering content to students. Other benefits include immediate teacher feedback, being able to help students who are technophobes, and dealing with network problems.

The advantages and shortcomings observed in online and F2F modes of instruction have led researchers to investigate which of the two modalities should be preferred and have attracted various comparison studies (Arias, Swinton, & Anderson, 2018; Darkwa & Antwi, 2021; Helm, 2014; Ni, 2013). Nevertheless, these studies reported mixed findings. For instance, Ni (2013) discovered that student performance does not depend on the F2F or online mode of instruction. Similarly, Paul and Jefferson (2019) showed no significant difference in student performance between online and F2F learners regarding gender and class rank. Shen et al. (2007) also said that studying online can be just as effective as face-to-face (F2F) instruction. Conversely, Helm's (2014) results showed that online students had significantly lower grade point averages, missed significantly more grade opportunities, and were more likely to fail the course compared to their F2F counterparts. These mixed findings may result from the differences in students' characteristics.

The reason is that it has been shown that student populations are becoming more heterogeneous (with different characteristics), resulting in more complications in designing appropriate instruction modalities (Lim & Morris, 2009; Navarro, Garca-Rubio, & Olivares, 2015). Consequently, this study aims to investigate the antecedent influence of some of these students' characteristics in two modes of instruction on their academic performance.

In comparative studies, students' age is one demographic factor that could account for differences in students performance in online and face-to-face education. Morin, Safaee, and Saadé (2019) found that older students have more confidence in their computer proficiency and are more likely to interact positively and actively engage in online lessons than their younger counterparts. In addition, they noted that classes contain a more significant proportion of older students than younger students who are already employed, goal-oriented, and self-directed; thus, the mode of instruction should be aligned with these students' characteristics throughout the course. The importance of instructional flexibility appears to be greater for older students than for younger ones. Similarly, Morin, Safaee and Saade (2019) also reported that students in the older category are more enthusiastic about participating in online learning as they feel stronger self-efficacy and mental readiness. Furthermore, other researchers (e.g., Lim & Morris, 2009; Navarro, Garca-Rubio, & Olivares, 2015; Slover & Mandernach, 2018) have shown that students respond differently to their studies according to their age. These studies showed that student's age is an important factor that can affect how well they do in both online and face-to-face settings.

The research community has identified socioeconomic status (SES) as another variable that could facilitate the effectiveness of online and F2F modalities to improve students' performance (Navarro, Garca-Rubio, & Olivares, 2015). Empirically, Gobena's (2018) study showed that

parents' educational attainment influences the student's performance; those students whose parents had higher degrees had better school performance. For the online mode of instruction to be successful, various technological tools are needed to access online teaching resources, such as phones, the internet, and laptops. The type of technological tools in the possession of students often depends on the SES of their parents or guardians and are pointers to whether students will have access to participate in online classes or not. Lee and Burkam (2002) showed that students who do not have prior experience with new technological tools are likely to find online learning challenging. In addition, research (e.g., Adebusuyi & Adebusuyi, 2020) has demonstrated that the type of institution students attends and the resources in their possession have mainly depended on their parent socioeconomic status. But there isn't a lot of evidence in the literature about how parents' socioeconomic status (i.e., ability to provide the necessary tools or resources) affects how well their children learn in online and face-to-face settings.

Research should also clarify how instructors can tailor their mode of instruction to students' course specialization. Colleges and universities offer various courses, each with its own requirements and stipulations. Educators must consider these course requirements and the mode of delivery when making pedagogical decisions. Though educational bodies are saddled with the responsibility of designing the courses of each program, the onus is on the individual educators to decide how they will deliver the course contents to their students. As part of their research on the effects of the coronavirus (F2F) on education, Darkwa and Antiwi (2021) analyzed the content students were learning before (F2F) and after the outbreak (online). According to them, more content-based hands-on activities were planned and executed before the pandemic (F2F) than after the pandemic (online learning). Also, it was observed that real-life practical examples aid students' comprehension of course material more in a F2F setting than in an online environment. So, studies

should look at how the course requirements and experiences of students in different education programs are different and use this information to find the best way to help students do better in school.

The aforementioned demographic factors may influence either teachers' or students' preferences for online or face-to-face pedagogy (Werhner, 2010). Furthermore, the types of students who thrive in each pedagogical approach are likely to vary. Consequently, this will have an impact on their academic performance. However, the literature fails to adequately address the importance of teachers knowing their students well enough to use that knowledge to guide their decisions about the best way to support "modality strategies" that can boost their students' performance. Therefore, this study examines how age, SES, and course of study affect students' performance in both types of instruction modalities.

Statement of Problem

Decision whether to fully transit from F2F to an online mode of instruction is a fundamental challenge for all educational parastatals. Students' demographic factors like age, SES and course of study may either improve or destabilize students' performance on online or face-to-face platforms. By paying close attention to these factors, the potential of these modes of instruction can be maximized. Therefore, research should consider the interaction effect of students' age, SES, and course of study, when utilizing either or both modes of instruction. Hence, this study was conducted.

Research Questions

1. Are there significant differences in student performance between online and F2F students enrolled in Science, Technology, Engineering and Mathematics (STEM) courses?

2. Is there any relative effect of age, SES, and course of study on student performance in online and F2F instruction?

Methodology

An ex post facto design was employed in the study. A total of 620 third-year undergraduate students (41% male and 59% female) from a large sample offering a STEM education course from a southwestern Nigerian university participated in the study. Werhner (2010) has queried that studies have failed to account for differences in students' characteristics in experimental online and offline classrooms in their design. To reduce the potential for bias associated with comparing students who are using different platforms, the present study collected data from the same students as they utilized multiple modalities of instruction. Students' performance records from the 2020–2021 academic session was used for the study. In Nigerian universities, one academic session comprises two sections; usually the first semester, often tagged as the harmattan semester, and the second semester, usually tagged as the rain semester. The students took online classes during the first semester (Harmattan) and face-to-face classes during the second semester (Rain). The scores of students from various departments offering a STEM course were analyzed. The same professor taught the course to provide comparable learning experiences across the two modes of instruction. The content and structure of the two types of classes were designed to be as similar as possible.

Instruments

Student performance and the SES scale were crucial instruments used to gather data for the study. Student performance was operationalized by calculating students' final grade point averages (GPAs), which are scores derived from continuous assessment and exam scores. Grade point averages were given a letter grade from A to E, with an A worth 5 points, a B = 4, a C = 3, a D =

2, and an E = 1 point. The percentage of students who got an A, B, or C was called the "success rate," while the percentage of students who got a D or F was called the "failure rate."

SES Scale

The SES scale was measured using the MacArthur Scale of Subjective Social Status by Adler et al. (2000). Previous studies like Allan et al. (2014); Douglass et al. (2017); and Adebusuyi & Adebusuyi (2020) have also used the same scale to measure students' socioeconomic status. The questionnaire comprised two sections: (i) Demographic information and (ii) a picture of a 10-step ladder was presented, and participants were asked to "Think of the ladder as representing where people stand in our society." Those with the most wealth, education, and employment opportunities are at the pinnacle of the social hierarchy. People with the least amount of money, the least amount of education, and the lowest-paying jobs or no jobs are the least privileged. Participants were asked to indicate their position on the ladder on a scale from 1 (bottom rung) to 10 (top rung). Participants' scores on the scale were coded and grouped into high and low SES. Those who indicated between 0 to 5 on the ladder were categorized as belonging to a low SES, while those who indicated from 6 to 10 were grouped as belonging to a high SES.

Data Collection Procedure

The second author, an assistant professor in the department of science and technology education at the institution where the study was conducted, taught two STEM courses to students from various departments throughout the 2020–2021 academic year. The courses were required for science and technology education (STE) students but were electives for students from other departments. Each semester ended with a midterm test and a final examination, and the scripts were graded and scored. After the session, the student's performance scores from both semesters

were compiled and ranked. The SES questionnaire was developed for students to declare their gender, age, course of study, devices owned, and the SES ladder indicating their socioeconomic status. The questionnaire was presented during one face-to-face class in the second semester, and about 80% of the available students responded instantly. In contrast, absent students were sent the questionnaire as a document on the course WhatsApp platform to be filled out and submitted electronically before the subsequent lectures. The students' grades and questionnaire answers were both coded and entered into SPSS along with each student's scores.

Data Analysis

The data analysis began with a search for entry errors that caused excessive numbers. We could track the errors because each questionnaire was marked individually before being entered into SPSS. Then, we utilized boxplots and histograms to identify and correct outliers. Students' "success rates" were defined as the percentage of those who achieved an A, B or C, and were coded as 1, whilst "failure rates" were assigned to those who received an E, D, or F and were coded as 0. According to Slover and Mandernach (2018), traditional-age undergraduate students (18–24 years) and non-traditional-age undergraduate students (25 and older) differ in their drive to attain academic achievement. Age was therefore categorized into four multicategory variables. While the course of the study consisted of three departments that participated in the study and were labeled as 1, 2, and 3, SES was categorized into low and high SES categories. To gain an overview of participant demographics, frequency, mean, and standard deviation were calculated, while the t-test and the analysis of variance (ANOVA) were utilized to answer the research questions. The statistical significance level was set at $p < 0.05$.

Results

Table 1

Descriptive statistics of the participants in the study

Variable	Scale	No of Students	Percentage (%)
Gender			
	Male	252	41
	Female	368	59
Department			
	STED	180	29
	ASSED	303	49
	HKHE	137	22
Age			
	18 – 24	436	70.3
	25 – 34	172	27.3
	35 - 44	11	1.8
	44 & above	1	2
SES	High	219	35.3
	Low	401	64.7
Devices			
	Personal Computer	36	22.4
	Mobile Phone	477	76.9

	None	4	0.6
Computer Literacy			
	Yes	523	84
	No	97	16
Applications			
	Zoom	3	0.5
	Google Meet	81	13
	Microsoft Teams	499	80
	Others	37	6
	Total	620	100%

Note: STED: Science and Technology Education Department

ASSED: Arts and Social Science Education Department

HKHE: Human Kinetics and Health Education

Table 1 shows the characteristics of participants in the study according to their demographic variables. The dependent variable is student performance, while the independent variables include age, course of study, and SES. The statistics in Table 1 showed that participants were a mix of older (29.7%) and younger students (70.3%). Most of the students indicated possessing either personal computers (22%) or mobile phones (77%), while only 0.6% indicated not possessing any technological tools and therefore do not have access to online classes. A higher percentage of students, 64.7%, indicated that they come from a low socioeconomic background, while only 35.3% come from a high socioeconomic background. The sample was also investigated

in terms of computer literacy. 84% indicated they were computer literate, while 16% were not computer literate.

Research Question 1: Are there significant differences in student performance when they take STEM course online or F2F?

To answer this research question, a comparison of students' GPA scores in both the harmattan and rain semesters was made. The result in percentages is presented in Table 2.

Table 2

Comparison of students' performance during the online and F2F mode of instruction

N = 620

Grade	Value	Online Classroom	Face to Face Classroom
A	5	7	7
B	4	95	110
C	3	222	248
D	2	242	186
E	1	54	69
Success Rate		52.3%	58.9%
Failure		47.7%	41.1%

Table 2 shows the comparison of students' performance when the online (Harmattan Semester) and F2F (Rain Semester) modes of instruction were used by lecturer during the

2020/2021 session. The results revealed that the success rate with respect to student grades is higher in the F2F classroom (58.9%) than in the online classroom (52.3%), while the failure rate is higher in the online class (47.7%) than in the F2F classroom (41.12%). Further analysis of the paired sample t-test (Table 3) was carried out to see if there was a significant difference between the scores of students in the two modes of instruction.

Table 3

Paired Sample t-test of students' performance in Online and F2F modalities

Paired Samples Test

	Paired Differences					T	Df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
Students Performance during Online & F2F	.066	.800	.032	-.129	-.003	2.058	619	.040

p < 0.05

Table 3 revealed a significant difference in student scores when using online versus face-to-face delivery modes (t-value = 2.058, df = 619, p-value =.040). According to the analysis, it was shown that students performed better when they engaged in F2F instruction (M = 2.68, SD = 0.93) than online instruction (M = 2.61, SD = 0.87). The t-value was statistically significant at the p < 0.05

level of significance. In other words, the students' performance during face-to-face instruction was much higher than during online learning. Therefore, the results suggest that face-to-face instruction is more productive than online learning in terms of student performance.

Research Question 2. Is there a significant effect of age, course of study and SES on students' performance in online and F2F modality?

An analysis of variance (ANOVA) was carried out to test the effect of each variable on performance, and the results are shown in Tables 4, 5, and 6, respectively.

Table 4

ANOVA Analysis showing relative effect of age on students' performance in online and F2F modalities

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
Online	Between Groups	6.47	3	2.156	2.76	.041
	Within Groups	480.852	616	.781		
	Total	487.321	619			
F2F	Between Groups	3.134	3	1.045	1.209	.306
	Within Groups	532.350	616	.864		
	Total	535.484	619			

Table 5

ANOVA analysis showing the effect of SES on students' performance in Online and F2F modalities

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
Online	Between Groups	8.71	1	8.712	11.25	.001
	Within Groups	478.609	618	.774		
	Total	487.321	619			
F2F	Between Groups	2.454	1	2.454	2.846	.092
	Within Groups	533.030	618	.863		
	Total	535.484	619			

Table 6

ANOVA analysis showing relative effect of course of study on students' performance in online and F2F modalities

Source		SS	Df	MS	F	Sig.
Online	Between group	37.589	2	18.794	25.785	.000
	Within group	449.732	617	.729		

		65.522	2	32.761	43.011	.000
	Between group					
F2F	Within group	469.962	617	.762		

Tables 4, 5, and 6 revealed the effect of each of the independent variables (age, SES and course of study) on students' performance in relation to the two modes of instruction (online and F2F). According to the results, there was a significant effect of age on students' performance during the period when an online mode of instruction was adopted $(F (3, 6.47) = 2.76, p = .041)$, but there was no significant effect of age on student performance during the F2F. This implies that age significantly has an influence in online classes but may not be equally as important in F2F classes. Similarly, there was a significant effect of SES on students' performance when the online mode of instruction $(F (1, 8.71) = 11.24, p = .001)$ was adopted. In contrast, during the F2F, the effect of SES was not relatively significant.

The course of study has a relative main effect on students' performance in both online $(F (1, 37.58) = 25.79, p = .000)$, and F2F $(F (1, 65.52) = 43.01, p = .000)$ modes of instruction. The result was further subjected to a post hoc test to know where the significance difference exists. The result of the analysis is presented in Table 7.

Table 7

A multiple comparison of the course of study's means using the Bonferroni post-hoc test

Dependent Variable		Mean		Std. Error	Sig.	95% Confidence Interval

	(I) Department	(J) Department	(I)	(J)	Mean Difference (I-J)			Lower Bound	Upper Bound
Performance in online	STED	ASSED	2.96	2.39	.575*	.080	.000	.38	.77
		HKHE	2.96	2.65	.311*	.097	.004	.08	.54
	ASSED	STED	2.39	2.96	-.575*	.080	.000	-.77	-.38
		HKHE	2.39	2.65	-.263*	.088	.008	-.47	-.05
	HKHE	STED	2.65	2.96	-.311*	.097	.004	-.54	-.08
		ASSED	2.65	2.39	.263*	.088	.008	.05	.47
performance in F2F	STED	ASSED	2.96	2.39	.738*	.082	.000	.54	.93
		HKHE	2.96	2.65	.658*	.099	.000	.42	.90
	ASSED	STED	2.39	2.96	-.738*	.082	.000	-.93	-.54
		HKHE	2.39	2.65	-.080	.090	1.000	-.30	.14
	HKHE	STED	2.65	2.96	-.658*	.099	.000	-.90	-.42
		ASSED	2.65	2.39	.080	.090	1.000	-.14	.30

Note*. The mean difference is significant at the 0.05 level.

Table 7 shows the multiple comparisons of the three courses of study so as to indicate the courses where a significant difference exists. From the table, it could be seen that there was a significant difference in the performance of students in science technology education department (STED) compared with the other two courses of studies. However, there was no significant difference between human kinetics health education (HKHE) and arts and social science education (ASSED). Students in STED performed best, with the highest mean (M = 2.96), followed by those

in human kinetics' and health education (HKHE) (M = 2.65), while the lowest performance was from students in arts and social science education (ASSED) with a mean of 2.39. This result suggests that the needs and activities of a course will go a long way toward deciding what kind of teaching mode could be used to help students do better.

Discussion

This study investigated the effects of students' age, SES and course of study on their performance to identify factors that can improve the efficacy of both online and physical modes of instruction. To investigate this, the differences in the performance of students' grade point average (GPA) in F2F and online modality were first evaluated. The result showed that students performed better during the F2F (Rain semester) mode of instruction compared to the previous semester (Harmattan semester), during which online modality was the only option for students. This finding is consistent with the results of Darkwa and Antwi (2021), who found that students who took the physical class outperformed those who took the online program. One possible explanation that could account for this finding is that students are already used to the F2F mode of instruction and may be finding it difficult to adjust to the new mode (online). Another explanation for the difference observed in students' performance in online and F2F modes of instruction might as well be linked to students' demographics like age, SES, and course of study, which were raised and tested in the present study. Thus, the ANOVA result showed that age as one of the demographic characteristics studied did not have a significant effect on a student's performance during the F2F modality; however, it had a significant effect on students' performance when the online modality was adopted. The result suggests that while age may not necessarily affect students' performance in a F2F classroom, it is an important factor to consider during online modality as, when adopted appropriately, it could enhance students' performance and nurture self-

development. This drives home the point that online programs provide an opportunity for older students, specifically those in the working class, since learning can be done when they are less busy (Morin, Safaee, & Saadé, 2019). The results support the submission of Slover and Mandernach (2018), who reported a significant correlation between student age and student scores in online learning. The finding also corroborates the work of Osei and Mensah (2011), who indicated that age was not a significant predictor of students' learning outcomes for on-campus students that receives F2F mode of instruction. Therefore, when the online mode of instruction is designed, it should be tailored more towards the older students who may not be completely present in F2F classrooms because of other work engagements.

Moreover, interesting empirical evidence was observed from the present study as regards the relative effect of SES on performance in online and F2F modalities. There was a significant effect of SES on students' performance during the online modality, but it had no significant effect on performance during the F2F mode of instruction. The effect observed during the online classroom could be a result of parents' SES, as parents' ability to provide all the necessary technological gadgets needed for online classes contributed to the effectiveness of the online classroom. Moreover, due to financial constraints, a larger number of students (64.47% of low SES) reported using their mobile devices only to access course materials and participate in discussions for their online courses. Students from lower socioeconomic backgrounds may be less likely to make the switch from face-to-face to online learning because they lack the resources essential to do so. When deciding what kind of teaching to do in the classroom, instructors should think about the resources available for the students to participate in online mode of instruction.

Another finding from the study indicates that there was a significant effect of the type of course on students' performance in both F2F and online modes of instruction. The uniqueness and

technicalities of each department's course of study may have contributed to the observed significant effect. For instance, science students take courses that require them to engage in practical activities that cannot be replaced entirely by virtual simulations. The same goes for students in human kinetics and health education (HKHE), where one of the required courses to take is the fitness and weight training course, which entails physical exercises. Thus, they will need the F2F exercises to acquire essential motor skills to be physically fit for their career advancement. Similar studies (Darkwa & Antwi, 2021; Hu-Au & Okita, 2021; Karki, Mahat & Kandel, 2021) have demonstrated that the modality and pedagogical approach in designing course content for students should be distinct, as an online mode of instruction may not be effective in teaching certain activity-based courses adequately. In particular, when the course is not required, as is the case with the STEM course offered in this study, it is necessary to devise teaching strategies that encourage students to enroll. Students from other departments who took the course as an elective (HKHE, ASSED) performed more poorly than those who registered it as a major course (STED), as demonstrated by the post hoc analysis in Table 7 in the present study. It's likely that these students from other departments haven't done STEM practicals in face-to-face classes before, and just showing them how to do them online might not only hurt their grades but also make them less likely to take STEM electives in the future.

The present study contributes to the ongoing dialogue regarding factors that can enhance learning effectiveness in online and face-to-face settings. The study suggests that in order to maximize the full potential of each mode of instruction, teachers should design the F2F modality, considering the type and nature of the course of study, while it is important to consider students' age and SES factors when designing online courses. In sum, the success of either online or face-

to-face instruction would depend on how well teachers, curriculum developers, and policy experts understand their students' characteristics and needs.

Conclusion

Findings suggest that students' age, SES, and course of study influenced their performance in both modes of instruction according to their peculiarities. It was also shown that while students' ages and socioeconomic status are important considerations when designing an online learning environment, students' chosen fields of study are crucial when planning a face-to-face mode of instruction. The practical work integrated into STEM courses may be why the F2F modality has such a noticeable impact on student performance. The results suggest several directions for further research, course improvement, and curriculum design. In particular, the instructor can use the online method of teaching in a classroom where most of the students have equally important engagements outside of class.

Recommendations

1. The study suggests that future research into the differences between the two ways of teaching should go beyond comparing grades and look at the demographics of the students. This information can be used to figure out which way of teaching will work best for each student.

2. Students who will take classes online should get training, and schools should make sure they have the technology they need to make online classes more effective than they have been in the past.

3. Curriculum planners and academic staff need to consider how to exploit and integrate the comparative advantages of different modes of instruction into specific courses in the future.

This can be done by giving classes both in person and online, as well as a mix of the two, to address the deficiencies found in each instruction modality.

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