Original Article

em foco
Revista Científica em Educação a Distância

ISSN 2177-8310
DOI: 10.18264/eadf.v12i1.1634

Intervening Outcome Factors in Remote Teaching: Does the Device of Access Matter?

Fatores Intervenientes de Resultados no Ensino Remoto: O Dispositivo de Acesso Importa?

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Abstract

This article analyzes educational results of remote education by the type of electronic device used to attend classes and to solve activities, as well how to attend classes (synchronous or asynchronous, normal speed or increased speed). The results of students from three classes of two teacher training courses of a public higher education institution in Minas Gerais were investigated. Based on online questionnaire, a statistical comparison of educational results was performed by the type of electronic device used and the way of attending classes, controlled by the presence or absence of admission by quotas (taken as a socioeconomic level proxy). It was possible to evidence that, for the sample, there was no statistically significant difference between grades of students who attended classes on desktop or laptop computers and those who used smartphones and tablets, but there is a difference in the performance of activities on both types of devices. There was also no difference between the grades of those who attended classes synchronously or asynchronously, or between those who attended classes recorded at normal or increased speed. It was admitted greater adequacy for the use of devices such as desktop and laptops computers and the synchronous monitoring of classes. There was a trend of better results for this situation in relation to the use of mobile devices, and the attendance of classes asynchronously.

Keywords: Remote teaching. Digital technologies. Evaluation of education. Educational outcomes. Higher education.

Recebido: 28/02/2021
Aceito: 24/01/2022
Publicado: 01/02/2022

COMO CITAR ESTE ARTIGO

ABNT: BRAGA, D. S.; BRESCIA, A. T. Fatores Intervenientes de Resultados no Ensino Remoto: O Dispositivo de Acesso Importa? **EaD em Foco**, v. 12, n. 1, e1634, 2022. doi: https://doi.org/10.18264/eadf.v12i1.1634

Fatores Intervenientes de Resultados no Ensino Remoto: O Dispositivo de Acesso Importa?

Resumo

Este artigo analisa resultados educacionais e avaliativos do ensino remoto em relação ao tipo de dispositivo eletrônico utilizado para assistir às aulas e para resolução de atividades, bem como a forma de se assistir às aulas (síncrona ou assíncrona, velocidade normal ou velocidade aumentada). Foram investigados estudantes de três turmas de dois cursos de formação de professores de uma instituição de ensino superior pública de Minas Gerais. A partir de questionário autoaplicado, foi realizado cotejamento estatístico de resultados educacionais pelo tipo de dispositivo eletrônico utilizado e a forma de se assistir às aulas, controlado pela presença ou ausência de ingresso por cotas (tomadas como proxy de nível socioeconômico). Foi possível evidenciar que, para a amostra, não houve diferença estatística significativa entre notas de estudantes que assistiram às aulas em computadores de mesa e notebooks, mas essa diferença ocorre quanto ao uso de dispositivos para a realização de atividades. Também houve diferença entre as notas dos que assistiram às aulas de maneira síncrona ou assíncrona, mas essa diferença não é percebida entre os que assistiram aulas gravadas em velocidade normal ou aumentada. Sendo assim, foi possível estabelecer admissibilidade de maior adequação para o uso de dispositivos como computadores de mesa e notebooks e o acompanhamento síncrono das aulas. Houve tendência de melhor resultado para essa situação em relação à utilização de smartphones e tablets, e do acompanhamento de aulas assincronamente.

Palavras-chave: *Ensino remoto. Tecnologias digitais. Avaliação da educação. Resultados educacionais. Ensino superior.*

1. Introduction

In March 2020, the World Health Organization declared a Public Health Emergency of International Concern regarding the outbreak of severe acute respiratory disease whose etiologic agent was the novel coronavirus SARS-CoV-2, Corona Virus Disease (COVID-19). The growth in the number of cases and deaths has made governments around the world, including Brazil, adopt, with greater or lesser degree of intensity, measures of collective distancing and (re)structuring of economic and social activities, in order to mitigate the effects of the disease and reduce the spread of contamination. One of the activities affected were those related to education, both at basic and higher levels, with face-to-face classes being suspended at all levels of education.

Throughout 2020 and 2021, the different educational systems began to replace face-to-face classes with different teaching-learning strategies, which received the generic designation of emergency remote teaching, in order to differentiate this from Distance Education, educational modality already consolidated legally, theoretically and methodologically. Because it is operationalized mainly, although not exclusively, in digital media (BRASIL, 2020), this teaching model took place in an interface with the limits and possibilities of using Digital Information and Communication Technologies in education (HODGES et al., 2020; VOSGEROU; BRITO; CAMAS, 2016).

In the last two years, the consequences of the pandemic (and the consequences of policies to face it) on the most different human activities have been the subject of investigations by governments, think tanks, scientific agencies and academia (TIZOTTE; THESING; GOMES, 2021).; VASCONCELOS; NASCIMENTO, 2020). The volume of publications on the repercussions of the pandemic on education in Brazil and in the world is also significant (ARRUDA, 2020; UNESCO, 2020). Among these productions, themes related to the mental health of students (DUTRA; CARVALHO; SARAIVA, 2020); to teaching (GARRIDO, 2020); the uses of technology in remote teaching (SOUSA, 2020) and gender issues in education (MEDEIROS; VERAS; BARBOSA, 2020).

Given this scenario, this research aims to investigate the relationship of components present in remote teaching and learning outcomes. More specifically, to analyze whether the type of technological device used to monitor classes and solve activities – desktop computers/notebooks and smartphones/tablets; and the way to attend classes – synchronously or asynchronously; normal speed or increased speed – intervenes in student grades. The interest of the investigated theme emerged from the teaching work by the authors, who sought to understand how students from teacher training courses with whom they work in a public higher education institution in Minas Gerais, access classes and activities in the context of teaching. remote in the Covid-19 pandemic; and whether these forms of access are related to outcomes. The objective, initially, was to provide subsidies for a better planning of classes and activities, in order to meet the demands and specificities of the students. During the execution of the research, there was an intention to incorporate the results into a research project, and it is possible that, in the future, this will be sent to the Research Ethics Committee of that institution.

The analytical hypothesis was that, although a significant part of the students had access to the internet via smartphones (IBGE, 2021), this would not be the best way to monitor classes and solve activities in remote teaching. In addition, it was based on the understanding that, by attending the live classes, students would have the opportunity to clarify doubts, delve into specific topics of the content and extrapolation to other topics of interest, which the monitoring of recorded classes, asynchronously, especially at increased speed, would bring limitations.

2. Methodology

To answer the title question of this work, namely, whether the technological device used and the way of attending classes (independent variables) are intervening factors of results (dependent variable) in remote teaching, the research adopted the following methodological procedures. At the beginning of the first semester of 2021, a questionnaire (Google Forms model) was sent to three classes of Physical Education and Biological Sciences courses who were studying the same subject (Public Education Policies) taught by the same teacher through e-mail. institutional mail of students. The questionnaire contained five questions that are listed in Table 1, in order to identify the way in which the participant entered the research, the technological devices he used to attend the virtual classes, the technological devices he used to carry out the proposed activities, whether he attended to classes synchronously or asynchronously and, if watched asynchronously, whether to increase the speed of the video or watch it at normal speed.

Table 1: Questions asked to the students participating in the research

1)	Did you join through quota policy? If yes, what was the type of quota?
2)	What technological device do you use, most of the time, to attend virtual classes?
3)	What technological device do you use most of the time to carry out the proposed activities?
4)	Most of the time, do you attend classes synchronously or asynchronously?
5)	If you watch classes asynchronously most of the time, do you watch the videos at normal or increased speed?

Source: self-elaboration.

The analysis of such questions made it possible to identify the profile of the students, seeking later to compare such information with the grades achieved by them in the disciplines. It is important to highlight that the teaching plan was the same adopted in all three classes, with diversified assessment activities. In all, 100 (one hundred) points were distributed, with 50% of the grade divided into two exams with objective and discursive questions, and the remaining 50% computed from a directed study, mental map, data collection, debate seminar, report technical and action plan. Both the exams and the other assessment activities dealt with topics related to public educational policies, according to the syllabus of the subject approved in the pedagogical projects of the courses.

Students who attended the entire course were included in the research, with exclusion criteria being those students who had their enrollment suspended and/or those who abandoned the training course (characterized by the non-performance of activities that added up to at least 50% of the grade course total). Seven students had a final grade below the minimum required for approval, being offered to them, according to the institution's bylaws, a special assessment to recover the grade. However, for the purposes of this study, the score obtained before the special exam was considered for the analysis of the influence of independent variables.

In all, 44 responses to the questionnaires were obtained, and only one student did not authorize the use of his information for the research, being, therefore, withdrawn from the analyzed sample. The answers received identification masks, to which the final grades of each student in the discipline were attached. The answers underwent statistical treatment and tables and graphs were built to present the results, discussed in the next section.

3. Results and Discussion

Of the total of 100 points, the average score was 79.5 (median 86), with a coefficient of variation of 23.7%. The lowest was 35.5; the largest, 100; and the average, 96. In view of the discussions on the influence of socioeconomic status on higher education outcomes (CREPALDE; SILVEIRA, 2016; TOMÁS; SILVEIRA; D'ALBUQUERQUE, 2020), the presence or absence of quota admission was used in this research, taken as a proxy for educational stratification. The data (Chart 1) show that 34.9% of the students in the sample entered using some type of quota.

Chart 1: Frequency and average of grades by presence or absence of quota inflow

	Frequency	Percentage	Average grade
Did not join by quota	28	65,1	82,1
Racial quota	3	7,0	75,6
Public school quota	9	20,9	80,7
Income quota	2	4,7	50,5
Combined quotas	1	2,3	65,0
Total	**43**	**100,0**	**79,5**

Source: own elaboration from research data

Although the average of the grades of students who did not enter by quota is higher, the one-way ANOVA showed that there is no statistically significant difference between the means of the quota groups [$F(4.38) = 1.588$; $p > 0.05$].

Regarding the second and third questions of the questionnaire, it can be considered that the analyzed students were divided in half regarding the type of device to attend classes and carry out activities, since

23 of them (53.5%) used computers desktops/laptops to attend classes and 20 (46.5%) accessed mobile devices. When comparing the data in relation to the presence or absence of quota admission, a tendency is observed for students who entered by quota to use more mobile devices, which may be related to present economic inequalities. For comparison purposes, in basic education, for example, the smartphone is the main device for accessing online classes among students from the public network (71%), while the presence of a computer is greater among students from private institutions (70%). (PANORAMA, 2020).

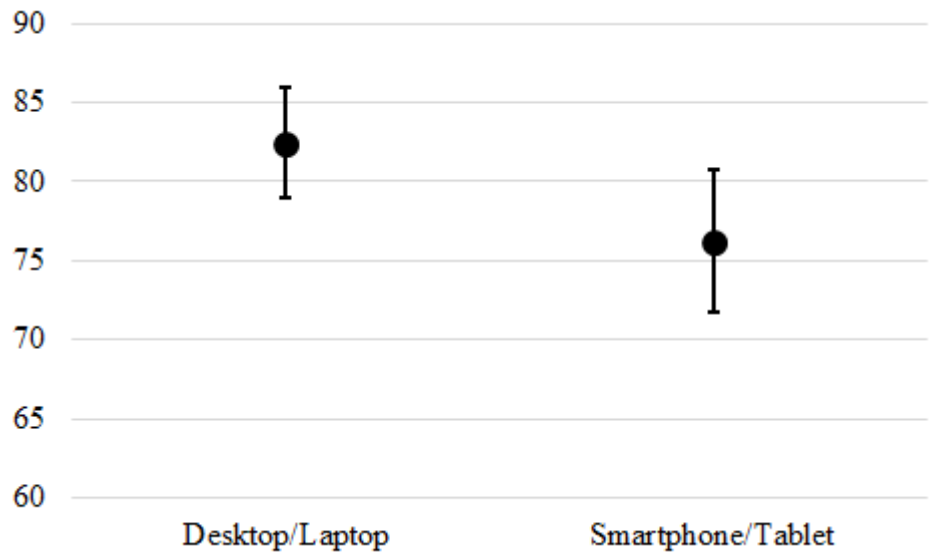
Chart 2: Percentage of the type of device used to attend classes and carry out activities due to the presence or absence of quotas

	Desktop Computer/Notebook	Smartphone/Tablet	%
Did not join by quota	53,6%	46,4%	100,0
Racial quota	33,3%	66,7%	100,0
Public school quota	44,4%	55,6%	100,0
Income quota	100,0%	0,0	100,0
Combined quotas	100,0%	0,0	100,0
Total	**53,5%**	**46,5%**	**100,0**

Source: own elaboration from research data

Although, in an independent t-test, there is no statistical difference between the grades of students who attended classes using desktop computers/notebooks and smartphones/tablets [$t(41) = 1.073$; $p > 0.05$], there seems to be a trend towards a better grade for the first group (mean grade 82.4) in relation to the second (mean grade 76.2). The graph in Figure 1 reveals this trend, by demonstrating that the confidence intervals coincide at the limit of the error bar. That is, it is plausible to assume that, with a larger sample, the difference in means between the two groups would be significant.

Confidence intervals (error bar graph)
Figure 1: Average grades by type of device used to attend classes

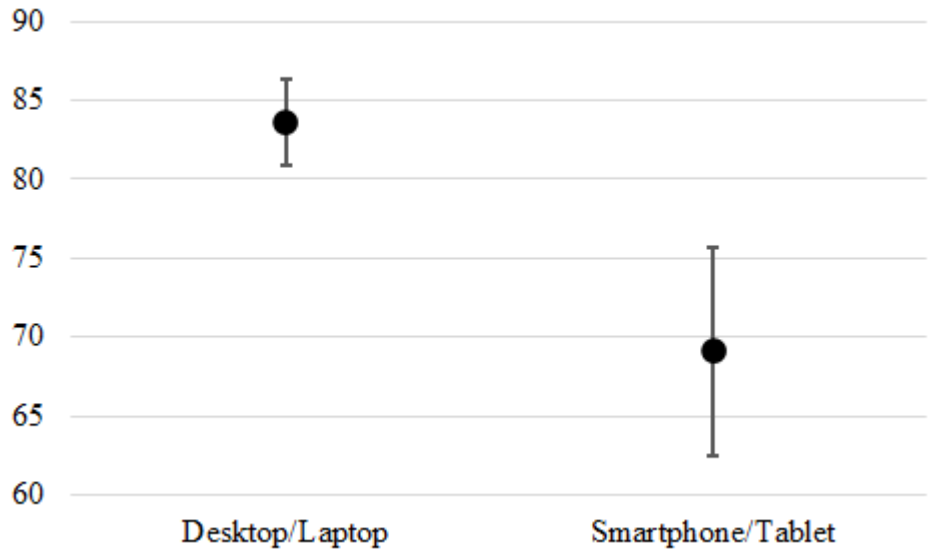


Source: own elaboration from research data

When analyzing the type of device used to carry out activities, it is possible to identify that there is a statistical difference [$t(14.57) = 1.984$; $p < 0.05$] between the averages of those who did the activities using

a desktop/laptop computer (83.6) and the student who did the activities using a smartphone/tablet (69.1). This significant difference is observed in Figure 2, in the non-occurrence of superposition between the confidence intervals of the means.

Figure 2: Average of grades by type of device used to perform activities and their confidence intervals (error bar graph)



Source: own elaboration from research data

Regarding the way, the student attends the class (synchronously or asynchronously), according to question 4 of the questionnaire, the highest percentages of those who watch the recordings, instead of the live classes, are quota students (Chart 3).

Chart 3: Percentage of the way in which classes are attended by attendance or absence of quotas

Synchronous	How they attend classes		Total
	Asynchronous		
Did not join by quota	67,9%	32,1%	100,0
Racial quota	66,7%	33,3%	100,0
Public school quota	55,6%	44,4%	100,0
Income quota	50,0%	50,0%	100,0
Combined quotas	100,0%	0,0	100,0
Total	**65,1%**	**34,9%**	**100,0**

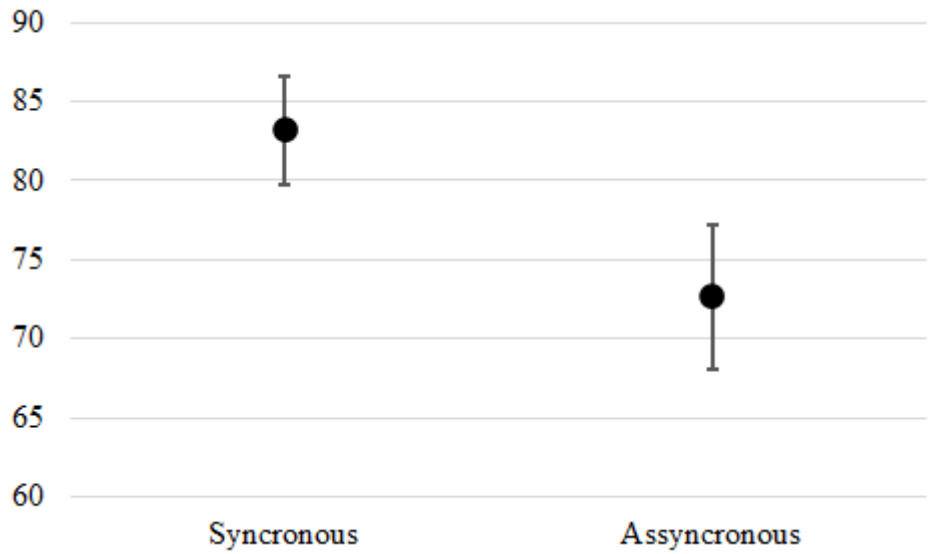
Source: own elaboration from research data

This may reflect that the most vulnerable social groups are those who need to share electronic devices and equipment with other family members (siblings who will attend basic or higher education classes, parents who are eventually in remote work, etc.) and/or who are working during class hours - a situation that is very common during the pandemic.

When comparing the grades between the groups that attended classes synchronously or asynchronously, it is also possible to notice a statistical difference between the students' grades [$t(41) = 1.790$; $p < 0.05$], with the averages of those who attended the live classes higher (83.2) than those who attended the recorded classes (72.7), as shown in Figure 3. to ask questions, to participate in debates, to listen to other

opinions, it is necessary for the learning process to occur in a more meaningful way, considering that this will be reflected in the evaluation grade.

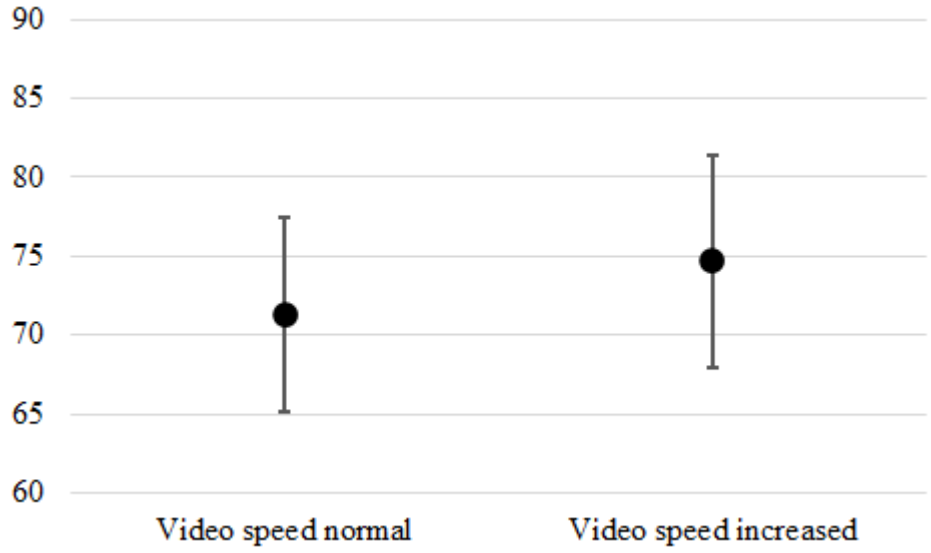
Figure 3: Average of grades by way of attending classes and their confidence intervals (error bar graph)



Source: own elaboration from research data

Finally, as for the speed of the video that the students who watched most of the recorded classes (question 5 of the questionnaire), it does not seem to make a difference in the grade averages. The average of those who watched at increased speed was higher (74.6) than those who watched at normal speed (71.3), but without statistical difference [$t(13) = -0.333$; $p > 0.05$], as observed in the coincidence of confidence intervals in Figure 4, it is not possible to conclude whether, for example, the student who watches at increased speed goes back and forth in the recording more frequently, in the case of non-comprehension of what was said.

Figure 4: Average of grades by speed of recorded classes and their confidence intervals (error bar graph)



Source: own elaboration from research data

For this independent variable, it is not possible to speak of a trend because, at the same time that, among

non-quota students, the averages are higher for those who attended classes at normal speed (85.8 against 67.6), the opposite occurs for public school students, in which the average grade for those who attended classes at increased speed was 88.7, while the average for those who attended classes at normal speed was 49.2.

4. Conclusions

Resuming the objective of this work, which is to analyze educational and evaluative results of remote teaching in relation to the type of electronic device used to attend classes and to solve activities, as well as the way to attend classes (synchronous or asynchronous, normal speed or increased speed), it was found that half of the students in the sample use mobile devices such as smartphones or tablets to attend classes.

As for the difference between quota holders and non-quota students in the option of the device being used to attend class, it can be seen that, among quota students (racial and income), the percentage of those who use these devices is significantly higher. In the same sense, it can be inferred that there is no statistical difference between the types of device used to attend classes, although there is a tendency for higher grades for students who attend classes using desktop computers and notebooks in relation to those who access them via smartphones. and tablets.

On the other hand, it is also inferred that there is a statistical difference between the types of device used to carry out the activities and between watching live or recorded classes, and it is still possible to conclude that there is no significant difference in educational results regarding attending classes. recorded at normal or increased speed.

As there is a tendency for lower grades for students who attended classes on smartphones and tablets, and as there was a difference between students who carried out activities on mobile devices and attended classes asynchronously; and as these are mostly quota students, it could be argued that the grades are a reflection of socioeconomic conditions and/or cultural capital. However, given that the results, when disaggregated by the presence or absence of quotas, are statistically equal, it can be inferred that, in fact, it is admissible that the type of device used to attend classes and carry out activities and the way of attending classes (synchronously or asynchronously) are intervening factors in educational outcomes.

It can be seen that, although the sample is small, the data seem to point to a greater suitability of desktop/notebook type devices and live participation in remote classes. However, they seem to corroborate the findings of the literature that discuss the inequalities of educational opportunities in the country.

It is important to emphasize, as a contribution of this work to remote teaching that continues to be developed in our country, that the results suggest that it is important for teachers to take into account that a significant portion of students do not use desktop computers or notebooks, but smartphones and tablets, which implies specifics of screen size and type of manipulation (eg writing texts, analyzing images or filling in worksheets) in their educational activities. Therefore, the planning of classes and activities for fixation, understanding and extrapolation of content, as well as evaluative activities, must take into account the operability on mobile devices (smartphones and tablets).

The data also suggest that teachers need to keep in mind that a considerable part of students do not attend live classes (due to work, device sharing, network instability, etc.), which leads to the need for other strategies. for resolving doubts and deepening content, such as developing doubt shifts or holding discussion and doubt forums, in virtual learning environments or in messaging applications.

As a limitation, this study did not take into account the teacher effect, suggesting further studies with different teachers and different teaching-learning strategies to assess other factors intervening in results in remote teaching. The small sample size is also considered to be a limit. Another important aspect that

this work did not consider, but which may remain as a possibility for further development and research, is the type of student internet (4G, Wi-Fi, shared) and speed, as well as the amount of packet data. of internet, as already experienced by these authors in synchronous classes in which some students report that the data package for the day has run out.

Biodata

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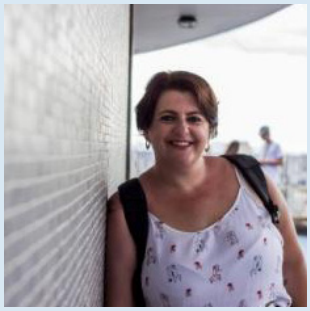

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