

## **Online and Face-to-Face Education**

What does the academic impact evaluation literature conclude about the differences in educational outcomes?

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### **Summary**

This publication reviews the academic literature on the differences in educational outcomes between online and face-to-face teaching. While online teaching can increase access to education, it often results in lower academic achievement and higher dropout, especially among students with lower previous performance, and can deepen inequalities. In contrast, blended learning, which combines online and face-to-face components, maintains the quality of learning and is a more effective approach, without compromising the quality of education. The flipped classroom, a variation of blended learning, also improves student performance, especially when it includes cooperative activities. The evidence highlights the need to balance access and quality in the implementation of online teaching modalities, considering alternatives that involve face-to-face components and active and cooperative learning methodologies. These findings are relevant to the recent national debate and MEC's policies on the regulation of distance learning.

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## 1. INTRODUÇÃO

In the last two decades, the field of education has witnessed an increasing integration of digital technologies in the teaching and learning process. One of the most prominent manifestations of this trend is the rise of online distance learning, which has been adopted by educational institutions around the world as a complementary or even primary tool for delivering educational content.

In Brazilian higher education, the online distance learning modality has gained more and more importance. Between 2009 and 2019, enrollment in distance learning undergraduate courses grew by about 192%<sup>1</sup> and according to the Higher Education Census (Brasil, 2022), in 2022, 66% of enrollments in higher education were in the distance modality. The growth of recent years was driven by the 2018 presidential decree, which made the opening of distance learning centers more flexible. When looking at the numbers for undergraduate courses, the presence of distance learning is even more striking: 81% of graduates took the distance course. In private education, which represents 82% of the total number of graduates of undergraduate courses, 93.7% of graduates obtained their diplomas through distance learning<sup>2</sup>. Teacher training is essential for the promotion of quality basic education. In a context where the vast majority of teachers in the country are obtaining diplomas through distance courses, it becomes even more relevant and urgent to reflect on the differences in educational results between online and face-to-face education.

The growth of online education is a relevant issue of public policy. The great proliferation of online education has been based primarily on the promise that the online format has the potential to improve access to education, especially at the tertiary level, and reduce the marginal costs associated with teaching more students. While it seems intuitive that online courses are cheaper than face-to-face courses, there is very little evidence about the costs of these formats (Xu and Jaggars, 2013; Escueta et al., 2020). Despite its great proliferation in the period of the COVID-19 pandemic, online education is not only a response to exceptional circumstances, but rather an educational trend that is shaping the future of learning. Understanding these impacts is an opportunity to rethink and reformulate our educational approaches, seeking to promote inclusion, quality, and relevance of education in an increasingly digitized and interconnected world.

This policy brief aims to consolidate the specialized literature on the impacts of online learning. In particular, it seeks to answer how online learning affects student retention and the

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<sup>1</sup> Source: <https://desafiosdaeducacao.com.br/licenciatura-tecnologicos-censo/>. Accessed on 05/27/2024.

<sup>2</sup> Source: <https://desafiosdaeducacao.com.br/licenciatura-tecnologicos-censo/>. Accessed on 05/27/2024.

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quality of learning and how this form of teaching can contribute to the equity of access to education. Finally, it is intended to indicate paths for future research.

In principle, teaching in the online format can be used at various educational levels. However, most of the literature to be discussed in this policy brief will study the impacts of the use of online education at the higher level. It is important to emphasize that the conclusions arising from these articles would not necessarily apply to other educational levels, even so they can inform us about the potential advantages and risks of online education at these other educational levels.

In the discussion about the impacts of online education, it is essential to understand the nuances and particularities of the different modalities of online learning. In particular, three modalities stand out in the specialized literature. The first modality is the one in which all classes of the subject are made available online asynchronously – 100% online education. The second modality is known as hybrid, which integrates components of both the fully online and face-to-face modalities. There is no exact definition of blended learning, and the studies that will be discussed in this policy brief present variations of blended learning. However, in general, the models discussed present the replacement of part of the classes that would be face-to-face with online classes. The last modality, which can be considered a specific case of hybrid education, is the flipped classroom. This is a model that is characterized by the change in the use of time inside and outside the classroom (Abeysekera and Dawson, 2015). In this modality, instead of the teacher giving a lecture during class time, students have access to this asynchronous online content and the class period is used for active learning, peer learning and problem-solving activities.

The evidence presented in this policy brief has been organized from these three main modalities of online education<sup>3</sup>. In section 2 we present the impacts of fully online education when compared to face-to-face education. In section 3 we present the impacts of hybrid online education. Section 4 presents a discussion about the impacts of the flipped classroom. Finally, in section 5 we discuss the results, reflect on the limitations of the studies analyzed and conclude.

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<sup>3</sup> In the annex to this policy brief, Table 1 presents a summary of these modalities and the impacts of these modalities suggested by the reviewed literature.

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## 1. 100% ONLINE EDUCATION

Most articles that study the impacts of 100% online education carry out impact evaluations to measure the effect of taking a specific undergraduate course in the online format versus taking the same course in person. Both Figlio et al. (2013) and Alpert et al. (2016) experimentally study the impact of online education for microeconomics students in American universities. In the first experiment, the materials available to students who take the online course are exactly the same as those available to students in the face-to-face course, the only difference between them is the way the classes are offered to the students. In the second experiment, the course consisted of an expository class and a discussion class, and in the online version the discussion was held asynchronously in an online forum. Both studies find negative effects on learning.

In a similar study, Chirikov et al. (2020) experimentally evaluate the impact of online education on students at Russian universities in mandatory engineering courses. However, the experiment was carried out in universities with resource restrictions to offer the subjects to all students, the online version of the course was offered through an online platform that consolidates courses from the best universities in the country. In contrast to the studies mentioned above, the authors did not find differences in performance between students who took the online and face-to-face courses. However, it is important to note that, unlike previous studies, not only the format of the course is different, but also the course itself and, potentially, the quality of it, since they are online courses from the best universities. One possible interpretation for this result is the fact that a higher quality online course may be able to offset the negative effects of online classes.

Two non-experimental studies stand out for being able to identify the causal impacts of online education in a wide range of disciplines from diverse areas. Based on a large administrative base of 34 technical universities in the United States<sup>4</sup>, Xu and Jaggars (2013) use the method of instrumental variables to estimate the effect of taking online courses on student performance. The results indicate that students who take the online courses are more likely not to complete the course and lower final grades. Bettinger et al. (2017) uses an administrative base of a large American private university, with 230,000 students from 750 different courses and a similar empirical strategy. In addition to finding similar effects on the likelihood of completing the course and final grades, the results indicate that there is also a negative effect on the future grades of these students<sup>5</sup> and the effects are, in general, greater for students with lower global averages. Finally, the results indicate that the effects are more pronounced in courses in the health area vis 'a vis courses in the areas of business and computing.

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<sup>4</sup> Approximately 19,000 students.

<sup>5</sup> Krieg and Henson (2016) also present evidence on the impacts of online education on students' future performance.

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In a complementary study to the previous ones, Cacault et al. (2021) experimentally evaluate the impact of providing the alternative of attending classes in economics courses (Introduction to Macroeconomics, Probability and Statistics, and Human Resource Management) via live stream. The authors' analysis suggests that students only resort to live streaming on days when the cost of attending in person is high (only 10% of classes) and encounter heterogeneous effects on learning: the option of attending class via live streaming generates negative learning effects on students with low ability and positive effects on students with high ability. Mechanism analysis suggests that both low-ability and high-ability students prefer to attend classes in person.

To what extent are students at other educational levels affected by online teaching? Heppen et al. (2012) experimentally evaluate the offer to 9th grade students from public schools in Chicago (USA) who failed Algebra I, to retake the course online. The results indicate that students who performed online recovery obtained worse grades than students who performed in person. In addition, these students were less likely to recover their credits.

One of the great motivations for the expansion of online education is the increase in access to education. However, there is very little evidence demonstrating any impact on access. Goodman et al. (2019) use the discontinuity regression method to estimate the impact of the availability of pursuing a master's degree in computer science online, 100% online, on access to higher education at the graduate level. The results indicate that the availability of the online course considerably increases the number of people enrolled in the course, suggesting that online course options can generate opportunities for individuals who would not otherwise seek courses and training.

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## 1. HYBRID EDUCATION

As with studies on 100% online education, the literature exploring the impacts of blended learning is mainly focused on experimental assessments that evaluate the effects of taking a course in a hybrid format versus taking the same course online or in person, with some studies being able to compare the three formats in the same assessment.

We highlight here two experiments that study the impact of hybrid learning environments. The first compares the performance of undergraduate students in the field of statistics in which one group had three hours of face-to-face classes per week and the other had only one hour supplemented by online exercises (Bowen et al., 2014). The second experiment tested the effects of reducing face-to-face class time in the microeconomics course for undergraduate economics students by offering online resources to all students, both those with reduced face-to-face class time and students with regular face-to-face class time (Joyce et al., 2015). Both studies do not find significant results on student performance related to more time in face-to-face classes.

Perhaps the most complete article on the subject of the online study is the one by Alpert et al. (2016), already mentioned in the previous section. The authors implement an experiment with two treatment arms and are able to compare in the same study the performance of students studying microeconomics 100% online, students taking a hybrid course – one face-to-face class per week for discussion and access to online content replacing the weekly expository class – and students taking face-to-face courses. As in previous studies, the authors found no differences in performance between students studying microeconomics in the face-to-face format and in the hybrid format.

Chirikov et al. (2020), cited above, also implements a two-arm treatment experiment. However, unlike Alpert et al. (2016), the study is not only studying the differences in student performance in the different formats offered by the course, since the online content made available, both in the 100% online format and in the hybrid format, is from a platform of courses from the best universities in the country. In the hybrid format, students have one online class per week and one class for discussion with the same professor who teaches the course in person. The authors also find no difference between the hybrid format and the face-to-face format.



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## 1. AN FLIPPED CLASSROOM

Although the flipped classroom is not exactly a replacement of face-to-face time for online time, but rather a different way of using students' time for learning, the evidence about this pedagogy can inform us about potential paths for the use of online tools, since the flipped classroom also uses online tools for students' time outside the classroom. Unlike studies on online and hybrid education, the studies on the flipped classroom represent slightly more varied contexts.

Harrington et al. (2015) conduct an experimental evaluation to study the impact of the flipped classroom on students taking theoretical courses in the first year of undergraduate nursing and finds no effect on students' performance in the tests<sup>6</sup>. Esperanza et al. (2016) experimentally evaluate the impact of the flipped classroom on performance and attitudes towards the study of mathematics in high school students. The results of the study indicate a positive effect on performance and students have more confidence to study mathematics and study with greater satisfaction. Wozny et al. (2018) evaluate the flipped classroom in the context of students of the introductory discipline to econometrics of the undergraduate course in economics. The results indicate that the students in the treatment group have better performances in the partial and final tests of the course.

Finally, Foldnes (2016) experimentally studies the effects of the flipped classroom on the performance of first-year undergraduate business students in mathematics and statistics. The author tests two flipped classroom models. In the first, students worked individually during the classroom period. In the second, the students worked cooperatively in groups. The experiment presented null results for the first flipped classroom model and the second model presented positive results when compared to the traditional face-to-face class, highlighting the importance of cooperative work in the flipped classroom model.

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<sup>6</sup> It is important to note that the study works with a relatively small sample of 82 students.

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## 1. DISCUSSION

The studies reviewed in this policy brief offer valuable insights into the impacts of online, hybrid, and flipped classroom courses on learning and student retention. 100% online education, often presented as a solution to increase access to education, has shown negative results in relation to student performance. While some evidence suggests that high-quality online courses can offset the negative effects of online classes (Chirikov et al., 2020), in general, studies point to a lower likelihood of course completion and lower final grades for students who take the online courses (Figlio et al., 2013; Xu and Jaggars, 2013; Alpert et al., 2016; Bettinger et al., 2017). In addition, evidence suggests that students with worse previous performance are more harmed by online education Bettinger et al. (2017); Cacault et al. (2021). In this way, this educational model can end up deepening learning inequalities among students.

Although evidence suggests that online education is capable of increasing access to education (Goodman et al., 2019), students, when they have the possibility of attending classes both in person and online and the cost of attending classes in person is low, most of the time end up opting for the first option (Cacault et al., 2021), revealing an important aspect that decision-makers should take into account when considering the possibility of implementing online education.

In the context of blended learning, the reviewed studies suggest that reducing face-to-face class time in favor of online components does not negatively affect student achievement (Bowen et al., 2014; Joyce et al., 2015; Alpert et al., 2016; Chirikov et al., 2020). This suggests that combining face-to-face and online activities can be a viable approach to delivering educational content, offering flexibility to students without compromising the quality of learning. However, it is important to emphasize the fact that this model has face-to-face components, it can make it difficult to fulfill the promise of online education to increase access to education. On the other hand, the implementation of these hybrid models has the potential to reduce the costs of offering courses and disciplines without compromising the quality of student learning.

As for the flipped classroom, which can be considered a particular model of hybrid education, the results are more promising, indicating that this approach can improve student performance (Harrington et al., 2015; Esperanza et al., 2016; Wozny et al., 2018), especially when combined with cooperative group activities (Foldnes, 2016). This suggests that time reversal in and out of the classroom, along with the use of online resources, can promote more effective learning by engaging students in a more active and collaborative way. But like the other hybrid models discussed above, this model will not necessarily contribute to increasing access to education.

The mechanisms by which the effects identified in the literature occur are still unclear. It may be that less structure for time management, fewer opportunities to interact with peers and teachers, the inability of teachers to adapt online content to the needs of students, or a

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combination of these compromise student learning in 100% online education and probably the formation of some socio-emotional skills (Escueta et al., 2020).

While the reviewed studies provide relevant insights, it is important to recognize their limitations, especially in terms of external validity. Many of these studies are experimental and may not fully capture the complexity of the actual educational environment. In addition, these experiments are implemented in very specific contexts, in particular, in undergraduate disciplines, mainly in the areas of economics and exact sciences, and in developed countries, and it is important to question whether these results would apply in other courses in other areas, at other levels of education and especially in developing countries such as Brazil. Furthermore, it is important to note that the quality of online courses and the way they are implemented can vary widely, in turn, influencing the results.

Despite the limitations mentioned, in general, the evidence indicates that the 100% online modality, even though it is a potential channel for increasing access to education, can offer a risk to learning compared to hybrid or face-to-face courses. This trade-off between access and quality has been present in the national debate on distance learning. At the end of 2023, the Ministry of Education (MEC) restricted the creation of new online courses<sup>7</sup>. and in April 2024, the MEC approved an opinion proposing that a maximum of 50% of the workload of undergraduate courses be offered in the distance modality<sup>8</sup>. With the great proliferation of online higher education courses, especially in the undergraduate degree, it is important that decision-makers consider alternatives that involve some face-to-face components, especially those that include active and cooperative learning methodologies, such as group discussion activities, problem solving, promoting interaction between students and interaction with professors.

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<sup>7</sup> <https://www.gov.br/mec/pt-br/assuntos/noticias/2023/novembro/portaria-suspende-processo-de-autorizacao-de-cursos-superiores-ead>. Accessed on: 05/27/2024.

<sup>8</sup> [http://portal.mec.gov.br/index.php?option=com\\_docman&view=download&alias=256291-pcp004-24&category\\_slug=marco-2024&Itemid=30192](http://portal.mec.gov.br/index.php?option=com_docman&view=download&alias=256291-pcp004-24&category_slug=marco-2024&Itemid=30192). Accessed on 06/10/2024

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## ANNEX

Table 1: Summary

Modality	Description	Main Impacts	References
<u>100% Online Education</u>	All classes of the course are made available online asynchronously	less probability of completing the course; lower final grades; more pronounced effects for students with worse previous performance; increased access to education	(Figlio et al., 2013; Xu and Jaggars, 2013; Alpert et al., 2016; Bettinger et al., 2017; Goodman et al., 2019; Cacault et al., 2021)
<u>Hybrid Education</u>	It integrates components of both the fully online and face-to-face modalities. It involves replacing part of the classes that would be face-to-face with online classes.	no effects on the likelihood of course completion or final grades are found	(Bowen et al., 2014; Joyce et al., 2015; Alpert et al., 2016; Chirikov et al., 2020)
<u>Flipped Classroom</u>	A specific case of hybrid education that is characterized by the change in the use of time inside and outside the classroom. Instead of the teacher giving a lecture during class time, students have access to this asynchronous online content and the class period is used for active learning, peer learning, and problem-solving activities.	improved student performance, higher final grades	(Harrington et al., 2015; Esperanza et al., 2016; Foldnes, 2016; Wozny et al., 2018)