Teaching and Learning in the Post-pandemic Context: The Teaching Perspective on the Use of Information and Communication Technology

Fabiana de Agapito Kangerski, Federal University of Santa Catarina, Brazil
Andreia de Bem Machado, Federal University of Santa Catarina, Brazil
Cristiano José Castro de Almeida Cunha, Federal University of Santa Catarina, Brazil
Solange Maria Silva, Federal University of Santa Catarina, Brazil
Gertrudes Aparecida Dandolini, Federal University of Santa Catarina, Brazil

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Abstract
The COVID-19 pandemic has precipitated an abrupt and unprecedented shift in the field of education. This subject demands thoughtful contemplation in the current moment, particularly concerning the future prospects stemming from these novel experiences. Therefore, the objective of this study is to analyze the implications of the use of ICT (Information and Communication Technologies) experienced by teachers during the emergency period of the pandemic on their teaching practice in face-to-face education. A qualitative approach was adopted, characterized by its descriptive nature, utilizing a field research methodology comprising semi-structured interviews conducted with seven educators from a public Brazilian institution specializing in professional, scientific, and technological education. The research findings indicate significant innovations in the dissemination of content, enhancements in the utilization of institutional mediation systems, integration of novel collaborative educational technologies, and an upsurge in the utilization of open educational resources (OER). At the micro level, the narratives unveiled fresh pedagogical practices and perspectives regarding ICT, alongside considerations for its continued integration into face-to-face instruction. Furthermore, the study highlights uncertainties pertaining to the future of education and the sociocultural implications arising from the digital culture.

Keywords: Information and Communication Technology, Professional Education, Online Teaching, COVID-19

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Introduction

In the era of connectivity, when everything is interconnected with cybernetic networks, the speed of transformations has turned the world digital. Many technologies duplicate very quickly due to digitization (Cabero-Almenara et al., 2021), and information and communication technologies (ICT), especially the digital aspects, are now a label in the knowledge society. Its massive use creates new scenarios for social, political, cultural, and educational performance, changing the context in which teachers and students work through the mutual construction of knowledge and sociocultural practices, which give rise to new educational formats, with no distinction of time or space (Fernández & Pérez, 2018).

As a result of the role that ICTs have played in all dimensions of society, in the educational context, it becomes relevant to interconnect them with the processes of cultural and social transformation created around their use (Villarreal-Vila et al., 2019). This scenario also brings new aspects to teachers' skills. Currently, it is addressed the development of teaching digital competences, a transversal competence that mobilizes skills for the critical and adequate use of information to transform it into knowledge, while responsibly using different technological and digital supports to inform oneself, learn and communicate in different scenarios and to incorporate ICT, in a technical, didactic and methodological way, in the educational context (Cabero-Almenara et al., 2021; Flores–Lueg & Roig– Vila, 2019).

The global health crisis caused by COVID-19 has brought the world unprecedented challenges. Faced with the impossibility of face-to-face interactions, educational institutions found themselves amid the task of abruptly adapting and transforming their practices. The challenge has become even greater in professional training institutions, where work practice is the object of teaching. From an optional insertion, in many systems and levels of education, the use of ICT was intensive and compulsory.

The academic literature presents studies in the educational context and the use of ICT during this emergency period. Singh and Meena (2022), for example, analyzed the difficulties and challenges faced by higher education teachers and students in India during the period of exclusively virtual teaching. Soto et al. (2022) assessed the digital skills of higher education teachers in Peru. While Diz-Otero et al. (2022) and Prieto-Ballester et al. (2021) classified such teaching skills in high school. However, it is noticed that there is a lack of publications in the field of Brazilian professional education related to the use of ICT and post-pandemic perspectives, and studies of an interpretive nature.

The experience of this period brings new learning, perceptions about the experiences, looks to the future, questions, and epistemological reflections on the role of ICT in education. It is these concerns that motivated the problematization of this article, expressed through the following research question: What are the implications of the use of ICT by teachers, during the emergency period of the pandemic, to teaching practice in face-to-face teaching? The context of analysis was that of Brazilian public professional education, with field research carried out with professors who teach in face-to-face teaching and who have worked in the online model mediated by ICT since the beginning of the pandemics.

The Role of ICT in Education

The term Information and Communication Technology (ICT) consists of a set of technical means, whether by wire, cable or wireless, that handles information and enables

communication. This term is usually used to address electronic and technological devices, including computer, internet, tablet, and smartphone, as well as other earlier devices, such as television and newspaper (Costa, Duqueviz & Pedroza, 2015).

Digital Information and Communication Technologies (DICT) refer to any electronic equipment that, when connected to the internet, can expand the possibilities of communication between users (Valente, 2013). Today, its dissemination has gained strength due to the current digital transformation of society. For the present study, the term ICT will be used because it encompasses, in a more global way, more than only digital technologies.

The occurrence of the COVID-19 pandemic accelerated the processes of digital transformation and, in many cases, highlighted social inequalities (Pacheco, Santos & Wahrhaftig, 2020). In the education field specifically, it increased the need to introduce ICT in teaching practices and the development of specific skills (Cabero-Almenara & Valencia, 2021).

Although the sudden shift from face-to-face teaching to the remote model was triggered by the pandemic and compulsory confinement, this fact is not a phenomenon that causes the disruption of models. In recent decades, the complexity of humanity's problems, the characteristics of the digital society, digital disruption, and the necessary organizational restructuring of all sectors (Pacheco, Santos & Wahrhaftig, 2020) were already pointing to new teaching-learning models. The changes in the transition from the knowledge society to the digital one has consequences for education and bring new learning contexts.

Pacheco, Santos and Wahrhaftig (2020) state that meeting the demands of the digital society entails new looks at the organizational and curricular structures of educational institutions. They also pay attention to an inversion of the model focused on teacher-student interaction, towards a model with student-centricity. There is a paradigm shift in teaching activities, which moves from being a content transmitter to a guide and mediator of student learning (López et al., 2020), becoming a central figure for training students in the critical and reflective use of ICT (Guillén-Gámez & Mayorga-Fernández, 2020).

When studying the mobilizing variables for the development of teaching digital skills, Cabero-Almenara et al. (2020) identified as major variables: i) teacher training, degree of knowledge and work experience; ii) the infrastructure and availability of digital technologies; iii) the time of use of ICT, inside and outside the room; iv) time available to prepare lessons; and v) the teacher's attitudes and beliefs in relation to the possibilities offered by ICT.

References in the literature accredit the importance of the ongoing process of teacher training for the use of ICT (Amhag, Hellström & Stigmar, 2019; Domingo-Coscolla et al., 2020; Dominguez et al., 2020; Gomez, 2017; Lopez et al., 2020), as well as the provision of technological and pedagogical support (Amhag; Hellström & Stigmar, 201 9). The incorporation of ICT in the teaching-learning process implies reflections that range from the analysis of the technology itself to, at a deeper level, the epistemological models involved (Flores–Lueg and Roig–Vila, 2019).

The applicability of ICT integrates other types of knowledge, as shown by the studies by Mishra and Koehler (2006), who developed the Technological Pedagogical Content Knowledge (TPCK) framework for interactional understanding between content, pedagogy, and technology. In the conception of Mishra and Koehler (2006|), technology cannot be treated

disconnected from the content to be addressed and the teaching-learning method, as they are central aspects of an educational model (figure 1).

Figure 1 – TPCK Model
Source: Mishra and Koehler (2006|)

Mishra and Koehler's (2006) approach brings specific constructs (content, technology and pedagogy) and emphasizes the possible relationships between knowledge, namely: technological content knowledge (reciprocal relationships between technology and content), and pedagogical technological knowledge (knowledge of the existence of technological resources for certain teaching-learning configurations) and, integration - pedagogical technological knowledge of content (TCPK), which emerges from the interconnection between the three constructs.

Method

The present paper is classified as a qualitative and interpretive research, whose central point is to capture and understand the point of view of those surveyed, that is, the meaning attributed (Creswell & Creswell, 2021), which will identify the learning of teachers resulting from experiences with the use of ICT in didactic-pedagogical practices, during the period of the COVID-19 pandemic, which can be applied in face-to-face teaching.

Data were collected from September to November 2021, with prior and voluntary consent, signed in a document that clarified the research objectives and respective ethical procedures. The respondents were seven professors from a Campus of professional, scientific, and technological education in the Brazilian public educational system, selected according to accessibility (Creswell & Creswell 2021). This unit offers integrated technical courses in Administration and Information Technology (professional training at high school level), subsequent technical courses in Lodging and Tour Guides (post-medium level training), technical courses in Environmental Management (higher level), in addition to initial and continuing training (extracurricular). During the pandemic period, the institution adopted the term non-face-to-face teaching to designate the teaching-learning activities developed during the pandemic period. This expression will be used throughout this study.

The following criteria were established for choosing professors: i) to have been part of the institution's permanent staff for at least two years; ii) teach on-site technical or technological courses (when outside the pandemic); and iii) having acted remotely, since the beginning of the pandemic crisis. Considering that it is a Campus with a great diversity of backgrounds among professors, however, with a small number per area of education, and for reasons of accessibility, it was not possible to select only professors who worked in the same area of knowledge. The Campus operated in virtual mode from March 2020 until the closing of this research (January 2022).

As a data collection technique, a semi-structured interview was used, which provided flexibility for inserting or reformulating questions (Flick, 2009), through interactions with the respondent. The interviews took place remotely, via Google Meet, with recording of the session, with the consent of the respondent. A free participation consent form was agreed with each participant. The preliminary interview script contained questions regarding perceptions about the understanding of ICT and its application for learning, methods and ICT tools applied during the pandemic and before the pandemic, mediation system employed, possibilities of adoption in face-to-face teaching and learning with the application of ICT during the period.

Seven teachers were interviewed. To ensure anonymity, a code was assigned to each of the educators (Table 1). In order not to make a gender distinction, they were all called respondent, teacher or investigated, without distinction. Of these, three teachers (A, B and C) have similar backgrounds – Literature, while the others have backgrounds in Agronomy, Administration, Social Sciences and Sociology, and History. The levels of education at which they operate are similar, ranging from integrated technical courses, subsequent technical courses (post-medium level training), technologist courses and initial and continuous training. Among those surveyed, only teacher F had previous experience in online education.

Respondent	Education	Teaching experience	Level of education
A	Literature Portuguese/English	27 years	Integrated and subsequent technician
B	Social Sciences and Sociology	10 years	Integrated technician
C	Literature Spanish	21 years	Integrated technician and Technologist
D	Agronomy	15 years	Technologist and subsequent technician
E	Literature English	17 years	Integrated technician, Technologist, and Initial and continuing education
F	Administration	13 years	Integrated technician, Technologist, and subsequent technician
G	History	10 years	Technologist and subsequent technician

Table 1 – Characterization of respondents
Fonte: Collected data (2021).

Each interview lasted 29 minutes on average. Data analysis was based on the Thematic Analysis technique by Braun and Clark (2011), inductively and deductively and at a semantic level. After transcribing the interviews, with the support of the Atlas Ti® software, the coding proceeded, observing the semantic contents derived from the research questions and latent data that emerged from the reports of the respondents. In the end, the definition and naming of themes resulted in five macro themes analyzed, namely: i) understanding and perception of

ICT in education, ii) adoption of ICT before and during the pandemic, iii) challenges, and iv) learning and implications for face-to-face teaching.

Results

In this section, the results are presented, subdivided according to the themes identified by the thematic analysis.

Understanding and Perception of ICT in Education

In general, the respondents say ICTs are devices, systems, software, and platforms applicable in the teaching-learning process. Regarding its importance in education, there is unanimity as to its relevance. teacher F perceives a movement that arises not only because of the pandemic, but also because of globalization and the existence of new generations, which are digital natives (Feixa & Leccardi, 2010). In the report of respondent E, such an application is something that currently permeates both the bureaucratic part of teaching, since processes, such as the class diary, for example, were fully digitized, as well as the teaching-learning process itself.

The reflection of ICT in education brought to respondents A, B, C and E notes referring to digital culture and the cognitive changes that digital technologies have been causing in individuals. In this scope, issues considered new and that enter the school environment were also cited, such as, for example, social networks and cyberbullying, especially with adolescent students, as attested by the investigated E: “How do we deal with this? We don't know, because we are also learning while it is happening”. Investigated C considers that ICT are also changing the perception of space, time, and accessibility to information. In this sense, the narratives of respondents C and E bring a new attribution to the teacher, which is to help students in the criticality and discernment of information that is valuable for the development of their intellect.

It was identified, in the statements of respondent A, the importance of the use of ICT associated with the area of professional technical training of the student, as well as the pedagogical practices of the teacher. This refers to the TPCK model by Mishra and Koehler (2006), that is, it makes an association with pedagogical issues and content mastery. The use of ICT, whether at a distance or in face-to-face teaching, needs to be rethought within the scope of professional education to have a meaning for the student, considered this investigated. As an English teacher, investigated A still suggests that ICT be found capable of enabling the student to create and understand discursive genres that will be part of their world of work. A similar concern integrates the thinking of teacher C: “it is no use for us to think that, now, as digital resources for education, it will be much better, it will not be, if your idea of education is traditional”, weaving some review of the technological application devoid of pedagogical changes.

The challenges related to pedagogical technological knowledge (TPK) (Mishra & Koehler, 2006) were commented on by respondents D and G, who work with practices that involve the areas of food production and tourism guiding, respectively. The difficulty of finding virtual laboratories, suitable applications, and designing classes with video recordings were identified as barriers faced in the adaptation of practical and technical content, previously taught exclusively in on site models.

Regarding training, during the period, the Institution scheduled lectures in the live system, dealing with these topics: strategies for carrying out non-face-to-face activities; mini workshops on creating videos, creating podcasts and longer courses, with technical support for

adapting content to non-face-to-face teaching. These trainings were promoted by a unit of the network specialized in distance education, whose membership was voluntary. A repository in the virtual learning environment MOODLE (Modular Object-Oriented Dynamic Learning Environment) was also created to share different practices, including the most advanced use of the institutional mediation system (Integrated System), class recording techniques, among other relevant subjects. Four respondents participated in internal training, and teachers D and E also took external courses. Of the respondents, only one did not participate in training.

Adoption of ICT Before and During the Pandemics

This analysis was subdivided into two subtopics: i) ICT for teaching-learning mediation and ii) ICT tools for teaching practice. Regarding the mediation of learning, all respondents reported using the institution's standard software, here called the integrated system (IS). Although the IS has unanimous application – as it is an official instrument, for respondents B and F, MOODLE, when compared in terms of resources, interactivity and visual, is superior to the IS. In contrast, respondent C was the only one who had a different perception of MOODLE. In her understanding, this resource is also outdated and far from the configuration of virtual environments accessed by students in their daily activities.

Respondents A, B, G and E reported the adoption of open educational resources (OER) such as, for example, videos, texts, and music – a routine that was already part of the face-to-face mode of operation. Although for certain areas there is an abundance of materials, such as videos on platforms such as YouTube, investigated E reported that many do not meet the pedagogical needs, which requires great dedication of time to analyze the contents, verify their feasibility to make them available to the student. His intention with curating OER is to encourage greater autonomy in student learning.

In the case of ICT tools applied in teaching-learning, Google Meet was the most cited by all respondents for holding synchronous meetings with students. Such adherence may be linked to the fact that the Institution uses the Google package for electronic communications, and this, at the time of the interview, allowed the recording of synchronous classes.

The other ICTs are quite varied (Table 2), including gamification applications, interactive whiteboards (Jamboard & Padlet) used in asynchronous and synchronous moments, exclusive social networks (Discord), platforms for creating videos (Flip Grid). One of the characteristics of the ICT tools adopted is the possibility of being used by different areas of knowledge. For respondent E, such tools emulate virtual environments that students are already used to using, indicating the possibility of transposition to the formal learning environment.

1.	*Discord* (1)	9.	*HP5C – MOODLE* (1)
2.	*Flip Grid* (1)	10.	*Jamboard* (1)
3.	*Google forms* (3)	11.	*Kahoot* (1)
4.	*Google drive* (2)	12.	*Libre CAD* (1)
5.	*Google Earth Pro* (1)	13.	*Mentimeter* (1)
6.	*Google keep* (1)	14.	*Padlet* (4)
7.	*Google meet* (7)	15.	Windows Board (1)
8.	Google agenda (1)	16.	WhastApp (7)

Table 2 – ICT tools adopted by teachers and citation frequency
Source: Survey data (2021).

Challenges

One of the themes that emerged as a challenge was the generational adaptation and engagement of students, especially teenagers, with the format of virtual classes. Three professors pointed out the lack that this method brings to socialization among them, from which learning also derives. They also point out the need for the student to have a more autonomous profile and attentive to the progression of their studies, a characteristic not yet shared by all of them.

Teachers A, B, C and E reported a concern with the lack of active participation by students in synchronous online classes. For respondent A, even if ICT tools enable interaction, not all students, for example, open the camera and there is no possibility of such a requirement, due to the different social realities of students. Moreover, in his perception, non-face-to-face teaching requires greater individuality from the student in the progression of his own learning. A similar report is shared by respondent B who, throughout the pandemic, after ongoing improvements in lesson planning, achieved greater student engagement in synchronous classes. He considers that such a result derives, also, from a synergistic effort of the pedagogical and course coordinators in the individual interaction with the students. Respondent A reported that the online learning Campus, belonging to the network, also provided important support to teachers during this period.

Another point that is also related to the engagement of academics was mentioned by respondent C and which refers to the difficulty of delineating a profile of the class at the beginning of the disciplines. The teacher compares that, in face-to-face interaction, this process is easier and closer. He points out that, in a possibility of hybrid teaching, an initial face-to-face meeting is strategic. As for teachers A and E, one of the measures applied to alleviate this barrier was the adoption of questionnaires to outline the student profile and expectations and initial presentation activities, using the creation of videos by students or interactive and collaborative panels.

From the analysis, access to ICT and scarce investments by the Institution also emerged as a challenge. Respondents D and E pointed out that, during this period, they discovered convenient technological solutions for the needs of their disciplines and student learning, however, free access is restricted to some experiments or is completely paid for, which prevents them from innovating some practices. Teacher E also pointed out that the available resources fall short of technological progress and that this can impact on a delay in the students' own cognitive development. In his words (author's translation):

> *It is rare to have a platform like this, which involves state-of-the-art technology and is free of charge. So, we will always stay there on the bank. In that sense, we are always a little behind. We do what we can, as education professionals, we go after every platform we can use.*

Respondent E mentioned, as an example, the use of virtual reality, something that he perceives as being difficult to achieve in the short term, "while other international schools are already using it, since 2017".

Lessons and Implications for Face-to-Face Teaching

The pandemic, in the perception of respondent F, brought a change without return, with innovations in countless areas, not being different in education. ICTs *"have shown themselves*

to be potent, they have shown potential, and the adequacy is up to us, because we cannot simply go back to face-to-face, to our normality of face-to-face presence and forget all that, we will need to add", he informed. For the teacher, the great lesson will be to consider digital culture in face-to-face teaching and proceed with the adoption of ICTs so that they can be used by society to produce value.

One of the respondents (E) stated that hybrid learning will be a new reality and that attention should be paid to the issue of socialization, especially with the public of adolescent students who live a unique period, due to their age group. Teacher B, on the other hand, considers that the change is not focused on ICT itself, but on the consideration of a new context that needs to be brought to light in education.

For the investigated individual D, the pandemic unveiled a new perception of ICT in their teaching practice. When working with subjects involving topography and georeferencing, for example, it became necessary to completely reconsider their methodology and discover technologies that were not previously used in face-to-face teaching, but were adaptable due to students' access to their own devices, which relates to the "bring your own device" (BYOD) movement. As explained:

> *I discovered a new world that I can use with students and in some ways much easier! For example, I realized that in geo-referencing classes I no longer need to use the Garmin GPS, which is available at the Institution, as it has much better cell phone technology. For me, ICTs have a very important pedagogical meaning.*

Two respondents (A and G) revealed their progression as teachers during the pandemic period, as they realized that, in the first half of 2020, there was an adaptation of what was available from the face-to-face to the non-face-to-face format. The three subsequent semesters, still in a 100% online learning environment, allowed for more critical planning, seeking to improve "teaching work" and open up new knowledge arising from training and daily practices.

Despite existing criticisms, the need for a mediation system in the non-face-to-face teaching period meant that the potential of the IS was better used to carry out activities with students and, also, as a repository of materials and academic records of classes taught and student assessments. This report was shared by respondents A, D and G. In an equivalent way, it is the adoption of MOODLE for extracurricular courses taught by teacher A, something that was not adopted before the pandemic.

For investigated C, this pandemic experience brought new perspectives to his lesson planning. The expectation is to continue working with shorter topics, which end in a period and contain small tasks, which help the student in the assimilation of knowledge.

The possibility of virtual interaction with the students is one of the lessons learned by researcher B, because according to this respondent, one of the riches of ICT is to enable this connectivity. As for investigated E, a practice that intends to continue beyond the new applied ICT is the provision of OER for students. Realizes that this initiative emphasizes continuous learning by students, giving students greater autonomy.

For teacher F and G, web conferences with different professionals open an opportunity for new interactions between students and the external environment, without depending on commuting and resulting costs.

Discussion

The teaching narratives show the understanding of the teachers that the educational experiences of the pandemic go far beyond the application of digital technologies, as they involve sociocultural issues. It also exposes concerns about the student's professional training, their profile and the use of ICT to generate value. This highlights what Flores–Lueg and Roig–Vila (2019) weave about the need for an epistemological debate on the topic in the educational field, leading to post-pandemic measures and ongoing adaptation to a framework of digital transformation.

Despite the diversity of teaching practices employed, there are obvious differences between teachers. At this point, relying on Mishra and Koehler (2006) and the reports, the need for debates on: i) technological content knowledge, which refers to the context, teacher and student profile and the specific areas of professional training in which each teacher works; ii) technological pedagogical content knowledge (TPCK), at a broad level, with discussions and dissemination of inter and intra-course practices and by teaching segments.

Regarding investments in infrastructure and digital technologies, one of the mobilizing variables of teaching digital competence (Cabero-Almenara et al., 2020), there is a lack of improvements in mediation platforms, as well as access to new digital technologies. However, the debate about technologies in education, in the empirical field researched, and the training of educators (Domingo-Coscolla et al., 2020), precedes or needs to occur in parallel with such efforts.

In terms of ICT used, in addition to the adoption of new digital resources, including OER, it was observed that there was teaching learning with the optimization of existing tools, underused before the pandemic. On the other hand, in the search for technological pedagogical and technological content knowledge (Mishra and Koehler, 2006), teachers faced difficulties related to the inadequacy of OER found or access to digital technologies that require financial contributions.

The core of teaching-learning in the student, student engagement in non-face-to-face teaching and the expectation of their autonomy is still something to be achieved. Digital technologies can become an important ally. However, it sends new lessons and efforts on the part of educators, educational managers, and students. Institutional support, with broad debate and the creation of new policies and programs aimed at teaching digital skills and future professionals, can become a prolific path opened in a period of abrupt changes.

Conclusions

The present study aimed to analyze the implications of the use of ICT, during the pandemic period, for teaching practices in face-to-face teaching, which took place from the perceptions of teachers of public professional education teaching. The interviews carried out demonstrated a variety of ICT used and an openness to the continuity of their use in face-to-face teaching. They also revealed issues of an institutional nature regarding teacher training, investment in ICT infrastructure for teaching-learning and, above all, the need for debate about educational policies, hybrid learning, student and teacher profiles and technological infrastructure in these new times.

The realization of this empirical research showed evidence that the total immersion in online teaching during the global health crisis caused by the Covid-19 pandemic, unveiled new teaching practices, looks, knowledge and generated uncertainties about the future of education and sociocultural issues arising from digital culture. It was found that innovations occurred in the way content was delivered, in the more effective use of existing mediation systems, in the adoption of collaborative technologies and in the greater use of OER.

The qualitative method made it possible to analyze the teaching narratives in relation to the adoption of ICT, in the challenging period of transposition from face-to-face to virtual teaching. The chosen research technique does not allow the generalization of the data, constituting a limitation of the study, however, it points to perceptions and experiences that, apparently singular, give voice and reflection to an important public – the teachers. More than reporting the technologies employed and their implications, the results demonstrate the real need for an epistemological debate in education, in this digital transformation movement, characterized by the perspective of lifelong learning, student autonomy and ubiquity.

Future research may focus on the development of teaching digital competence, sharing practices and specific policies for educator training. In this transformation scenario, it is also relevant to listen to the students' vision, how they feel and think about it. In this line, empirical research with students becomes relevant, especially due to the tendency of the teaching-learning process to be more focused on the student, with the teacher, a mediator of this process. And so, the responsibilities of both increase: the student, since they are the protagonist, and the teacher, since they have to offer a more personal education.

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Contact email: fabiagapito@gmail.com