

Pedagogical practices based on areas of knowledge: Reflections on the technology use

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Abstract

The appropriation of technologies in education must consider the specificities of each knowledge field and propose the demand for its pedagogical use. In distance learning (DL), which relies on the use of technologies, the reflection on the use of this resource becomes fundamental. Processes, methodologies and materials are usually standardised due to time and production costs. It is necessary to identify an intermediate point in this standardisation that takes into account the specificities of the knowledge fields. This study aims to discuss the pedagogical practices in DL considered appropriate to the knowledge fields, in the appropriate combination of contents, technologies and pedagogical practices. The methodology adopted is qualitative, using survey as a data collection tool. In conclusion, this article indicates that there are, actually, more effective teaching practices for each knowledge field. There are still recommendations in order to study deeply the real learning in each teaching practice.

Keywords: Higher education, distance learning, pedagogical practices, education technology, TPACK.

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1. Introduction

The appropriation of technologies in education must consider the specificities of each knowledge field, and then propose the demand for their pedagogical use (Koehler & Mishra, 2005, 2008; Oliveira & Piconez, 2016; Shulman, 1986, 1987). In distance learning (DL), which relies on the intensive use of technologies, the reflection on the use of this type of resource becomes increasingly fundamental (Alfa, Medayese & Owoyale, 2019; Garbin & Oliveira, 2019).

Processes, methodologies and materials are usually standardised due to time and production costs (Shearer, 2003); thus, it is necessary to identify an intermediate point in this standardisation that takes into account the specificities of the knowledge areas. In this sense, this article aims to discuss the pedagogical practices in DL considered appropriate to the areas of knowledge, specifically in the appropriate combination of contents, technologies and pedagogical practices in the teaching of different knowledge fields.

Currently, universities that offer distance learning programmes tend to use, even for financial reasons, the same content presentation model, without taking into consideration the specificities of each knowledge field. Aiming to solve this problem, in mid-2018, an institutional project was created in a Brazilian university that proposes the creation of a model taking into account the nature of the knowledge, in the context of DL (Keser & Semerci, 2019).

For this reason, the institution set up a multidisciplinary working group that aimed to design new models that offered content based on the field of knowledge. For this purpose, we choose to use the table of knowledge fields established by the Coordination for the Improvement of Higher Education Personnel (Coordenação de Aperfeiçoamento de Pessoal de Nível Superior – Capes, 2018), a Brazilian institution. The proposal of the project developed arises from the need to rethink the model offering content, privileging the specificities of each knowledge field, as well as the experience acquired during the first 5 years of the university. The project has six steps: (1) organisation of the content by knowledge field; (2) preparation and application of a survey based on the Brazilian National Curriculum Guidelines; (3) conduct focus groups to collect problems and suggestions relevant to each area; (4) data analysis and construction of models; (5) interviews with the subjects to validate the model; and (6) application of the subject models for those contents.

After the curriculum organisation described in step one, it was observed that the institution has the following areas, based on the Brazilian reference (Coordenação de Aperfeiçoamento de Pessoal de Nível Superior—Capes, 2018):

1. Exact and Earth Sciences
2. Engineering
3. Applied Social Sciences
4. Humanities
5. Linguistics, Letters and Arts
6. Multidisciplinary

As per the second step, a survey was applied via Google Forms to students enrolled at least in the second semester of the undergraduate programmes, and this article focuses on the results obtained in this specific question: ‘My teachers appropriately combine content, technologies and pedagogical practices in the teaching of [Exact and Earth Sciences; Engineering; Applied Social Sciences; Humanities; Linguistics; Letters and Arts and Multidisciplinary]’.

The context in which the project is in development is the Virtual University, Sao Paulo State (Univesp), created in 2012 as a public virtual university, as its name, and has its mission based on the promotion of knowledge as an open good; universal access to formal education and citizenship education; and the use of innovative methodologies and technologies applied to education. Its first

entrance exam was in 2014 for the undergraduate degree in teacher training for chemistry, physics, biology and mathematics, and also in a bachelor's degree in production and computer engineering.

Since 2017, the institution began an expansion process that increased the number of vacancies and courses offered, such as pedagogy and public management. Thus, with the increasing offer of courses in the various knowledge fields, the concern for the used content model available has become constant: which are the pedagogical practices more appropriate for quality training in each knowledge field (Ciburiene, Bernatonyte, Simanaviciene & Startiene, 2019).

Many discussions have taken place at university level regarding the format of the contents, both from the didactic and the learning points of view. Some needs were identified, such as greater interaction between students and teachers, and more applied and practical content and tools that engage collective and collaborative work, since all programmes are offered in the same model in the Virtual Learning Environment (Feyisayo, Kareem & Oluwasegun, 2019).

2. The Technological Pedagogical Content Knowledge (TPACK)

Since the 1980s, Lee Shulman (1986, 1987) indicated that teaching action must be based on two pillars: content knowledge and pedagogical knowledge. The first one refers to the specific concepts and procedures of each field and the second understands what the teacher needs to know about the practice of teaching and learning in terms of didactics, assessment, curriculum, etc.

The intersection of these two knowledges is named as pedagogical content, which reflects on promoting learning in a particular field of a specific knowledge. This indicates that each knowledge field must have different forms of pedagogical treatment, for example, teaching languages require different didactic strategies from those employed to promote the learning of mathematical concepts.

However, in recent decades, it is not enough to know the specific content, the pedagogical bases or the pedagogical knowledge of the content. Active methodologies and the intensive use of digital technologies are two forces that act for the change in this scenario, which led to the emergence of the TPACK.

This approach, initially proposed by Koehler and Mishra (2005), represents the appropriation of technology in the teaching and learning process about a specific subject becomes relevant.

Adding the technological knowledge to the structure of Shulman, Koehler and Mishra indicates that teaching and learning process needs to be guided by pedagogical, content and technological knowledge. In this sense, in addition to specific didactic methodologies for each field of the knowledge, there are also specific technological appropriations for the teaching of contents of these areas. This integrative vision lies at the centre of the structure, developed by the authors to represent the theoretical approach.

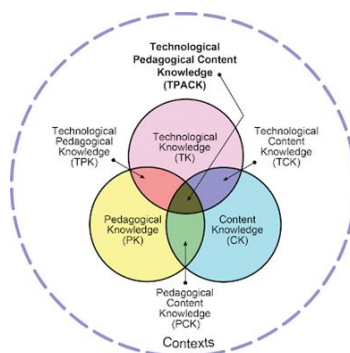


Figure 1. TPACK theoretical framework (available at https://upload.wikimedia.org/wikipedia/commons/2/20/TPACK_pt-BR.png)

Therefore, TPACK is really about a body of knowledge that goes beyond the pure and simple junction of the three parts that comprise it, and the interaction between pedagogy, technology and specific content, culminating in a process of teaching and learning with significant and deeply structured technologies use. According to Koehler and Mishra (2008), in practical terms, the application of this explanation model of teaching action is founded based on as the following:

1. Didactic representation of a specific concept by using technology.
2. Didactic methods that use technology to construct knowledge.
3. Knowledge of what factors hinder or favour the learning of specific content and how technology can help students achieve their pedagogical objectives or to develop skills and competences.
4. Science of how technologies can be used in building existing knowledge and the development of new epistemologies or the strengthening of old ones.

These definitions reveal, from Oliveira and Piconez (2016), that there is no unique pedagogical solution that is valid for any situation in an educational context. Each situation that occurs in a teaching and learning space can be solved or supported by a combination of their own or joint texture TPACK component elements at different levels or depths.

Since the rise of the TPACK model in academia, several studies have addressed its use in some knowledge fields. For example, Koehler and Mishra (2008) organised a handbook in which there are aspects of TPACK in basic education in fields such as social sciences (Lee, 2008) and arts (Deplatchett, 2008).

The same occurs in Herring, Koehler and Mishra's (2016) study, which brings TPACK practices in specific fields, with emphasis on face-to-face higher education. However, there is no clear correlation in the classic between books and articles on TPACK and its use in DL (Oliveira, 2019).

3. Method

This article is part of a project in development at the Virtual University of Sao Paulo State, and it focuses in identifying which are the pedagogical practices appropriated for quality training in each knowledge field.

For data collection, a survey was applied to the students, and according to Gil (2008, p. 121) it is 'a set of questions that are submitted to people for the purpose of obtaining information about knowledge, beliefs, feelings, values, interests, expectations, aspirations, fears, present or past behavior, etc.' This procedure was selected as data collection, especially because 'it makes it possible to reach large numbers of people, even if they are scattered over a very large geographical area' (Gil, 2008, p. 122).

This article is focused on the data collected on the question 'My teachers appropriately combine content, technologies and pedagogical practices in the teaching of [Exact and Earth Sciences; Engineering; Applied Social Sciences; Humanities; Linguistics; Letters and Arts and Multidisciplinary]', taking into consideration the areas that exist for each undergraduate programme. The above-mentioned question was based in the principles of the TPACK survey and uses a five-point Likert items considering 1 as totally disagree; 2 as disagree, 3 as neutral, 4 as agree and 5 as totally agree.

The survey was built and available via Google Forms, being applied to the students enrolled at least in the second semester of the courses, and were available to students for 10 days and had the following number of responses: 2,278 (engineering, computing and production), 573 (public management), 741 (teacher training in mathematics) and 2,292 (pedagogy). The questionnaire was applied by course and not by area, by an option of the project team, to enable the design for specific strategies.

4. Results

The data obtained in the questionnaire question are shown in Tables 1–4. They show the evaluation of the combination of contents, technologies and pedagogical practices in the teaching of each knowledge field that makes up the courses.

Table 1. Knowledge fields present in computer engineering and production engineering

Knowledge field	1	2	3	4	5
Linguistics, languages and arts	97	181	473	715	812
Humanities	90	167	500	766	755
Exact and earth sciences	143	229	429	634	843
Engineering	104	197	513	714	750
Multidisciplinary	206	208	530	662	672
Applied social sciences	117	165	602	719	675

Table 2. Knowledge fields present in teacher training in mathematics

Knowledge field	1	2	3	4	5
Linguistics, languages and arts	59	61	179	210	232
Humanities	21	55	147	241	277
Exact and earth sciences	29	60	144	243	265
Multidisciplinary	55	71	184	217	214

Table 3. Knowledge fields present in pedagogy

Knowledge field	1	2	3	4	5
Linguistics, languages and arts	135	156	441	613	947
Humanities	77	120	414	630	1,051
Exact and earth sciences	448	285	602	453	504
Multidisciplinary	14	171	466	597	913

Table 4. Knowledge fields present in public management

Knowledge field	1	2	3	4	5
Linguistics, languages and arts	11	26	95	168	273
Humanities	12	26	94	177	264
Exact and earth sciences	59	61	143	146	164
Multidisciplinary	29	37	146	183	178
Applied social sciences	19	23	128	195	208

As can be seen in Table 1, the pedagogical practices of the engineering area are evaluated by students as 33%, on the Likert scale, attributed 5; 31% assigned 4; 23% assigned 3; 9% assigned 2; and 4% assigned 1. For exact and earth areas, for example, 37% of the same students assigned 5, while for multidisciplinary this number was 29%.

Comparing the tables, it can be seen that the pedagogical practices of the applied social sciences area are evaluated slightly differently by engineering students and public management students: they concentrate 70% of their grades in 4 or 5, while 62% of engineering students rate with 4 or 5. It also proportionally changes the lowest grades, i.e., 7% of the public management students rate these pedagogical practices with concepts 1 and 2 on the Likert scale, while in engineering courses this percentage reaches 12%.

This is due to the fact that, according to Koehler and Mishra (2008), a cornerstone to be considered in the planning and execution of teaching and learning activities with technology is the educational context, including the target audience. Each type of student, for instance, performs their learning in a manner appropriate to their field, age and social class, among other factors.

For the exact and earth sciences area, by comparing the four graphs, it can be understood that the engineering and mathematics degree courses are the ones that consider the most appropriate pedagogical practices: 65% of engineering students rated 4 or 5 of these pedagogical practices, in the Likert scale, while in the mathematics degree this number reached 69%. On the contrary, in the public management course there are 54% in the same assessment range and 44% in pedagogy.

While these data may show a predisposition for some courses in the field of exact and earth sciences, they indicate that the courses with the highest ratings may have pedagogical practices that serve as an example for others. Even Oliveira (2019) indicated that there are clear, in TPACK frameworks, and that there are ways of thinking in particular to each field of knowledge.

A teacher or professional of the education structures his thinking differently from a teacher or professional of engineering: it is an aspect of content knowledge. Thus, this possible predisposition can be explained as not only a part of the framework, but also a point to be considered in the planning, implementation and evaluation of educational practices.

The mathematics degree course is the one that has students who evaluate the pedagogical practices of the humanities as the most appropriate: 79% rated with 4 or 5 on the Likert scale. Public management (77%) and pedagogy (73%) were also above 70%, but the engineering course adds up to 67% in this assessment range. These data indicate that the subjects of the mathematics degree course deserve attention, since there should not be, in this correlation, the predisposition factor, as indicated in the exact sciences.

This case seems to demonstrate a case of success in teaching technology-specific fields, as content knowledge does not influence learning as much as it does in exact and earth sciences. The practices of the didactic representation of concepts using technology (Oliveira & Piconez, 2016), in this case, were satisfactory for students from other fields than their own.

The course with the best evaluation in the area of linguistics, letters and arts is public management: 76% of the students ranked, following the Likert scale, with 4 or 5. The other courses had a lower evaluation: in engineering and pedagogy, 67% of the students ranked in the same range of the scale, while in mathematics degree 59% were in the same range. As it is an area of support to the courses, i.e., it is not the specific focus of any of them, the experience of the subjects of the public management course can be critically analysed and replicated in the subjects of the other courses.

In the multidisciplinary area, it is clear that pedagogy has the best rates: 40% rated the pedagogical practices with 5 on the Likert scale, and 26% rated 4, totalling 66%. In the other areas, the numbers were between 58% and 63%, highlighting the fact that in these areas the number of respondents is well divided between 4 and 5. This difference is basically due to the dynamics of the interdisciplinary project based in problem-based learning (PBL), which is distinct for the pedagogy course, with more structured materials and clearer correlation of the selected theme with school practice.

In the case of linguistics, letters and arts, as well as multidisciplinary, it is possible to verify how, in education, it is not viable to thinking on a single teaching solution valid for all contexts (Koehler & Mishra, 2008). Each case, with its particularities and contexts, needs an appropriate response to its demands.

5. Discussion

In the area of exact and earth sciences (e.g., calculus and physics), most of the video lectures are of the expository type, with explanation of concepts; the evaluative activities and support to the study are mostly exercise lists. Interactive features are used less frequently.

In the area of human sciences (e.g., sociology and education), video lectures are used for discussion, so that the other materials complement them. There are debates, documentaries, interviews, discussion proposals in forums, as well as production and reuse of interactive resources

that best demonstrate the practices or make the student the producer of their learning. Evaluative activities require student reflections.

In the area of applied social sciences (e.g., administration and law), most of the video lectures are of the expository type and the activities involve the retaking of concepts. Little interactive features are explored, such as forums and games, and other non-reading or video links.

In the area of engineering (e.g., materials and automation), video lectures focus on concept exposure, as well as technical visits to companies or interviews with professionals. Activities, resources and links emphasise on content articulation and professional practice through contextualisation and scenario description.

In the area of linguistics, letters and arts (e.g., Portuguese and English), video lectures and activities usually have contextualisation, linking practice to everyday situations. Interactive features like games and forums are also used.

In the multidisciplinary area (e.g., methodology and the interdisciplinary project based in PBL), there are few video lectures. The activities are practical and the resources and links selected are all in order to foster the practices.

6. Conclusion, findings and recommendations

In conclusion, the data from the survey require further studies on other data collection methods with regard to pedagogical practices in the area of engineering, applied social sciences and exact and earth sciences; although there is a high level of approval, these are given by students who, by the type of knowledge of the course, would be more predisposed to them. This deepening was already foreseen in the next phase of the project. The areas of humanities, linguistics, letters and arts, and multidisciplinary bring elements for positive considerations of pedagogical practices because they are well evaluated by different areas from the original courses.

It is possible to verify that there are pedagogical practices in DL that can be more effective for each area of knowledge. In fact, the questions of the questionnaire analysed do not imply whether there was learning of a certain concept, but rather the students' perception of the pedagogical use of technological tools in teaching practices in the area. However, since the use of technology is not a natural factor, but intentionally constructed, it is worth highlighting the role of the actors in the educational process – teachers, mediators, instructional designers, etc. – in the construction of technology appropriation in DL.

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