

# FIRST ANALYSIS OF TPACK SURVEY RESULTS APPLIED TO BRAZILIAN DISTANCE LEARNING STUDENTS

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**Abstract:** *The desirable knowledge for teachers to teach in the 21st century involves pedagogical knowledge, content knowledge and technology knowledge - summarized in recent studies as Technological Pedagogical Content Knowledge (TPACK). In order to identify the competence levels in each of the domains of the TPACK, a survey was developed and, for this PhD's research, was translated, adapted and applied to students from four undergraduate courses (Physics, Chemistry, Biology and Mathematics) from a public distance university - elements of the methodology of this research. In this sense, the present paper aims to analyze the data collected on technological knowledge from TPACK Survey. As a result of the questions, it is clear that the students who answered the questionnaire perceive themselves with satisfactory standards of mastery of the use of technologies, as well as it was registered that they demonstrated that the fact of studying in a distance course is decisive in order to improve the mastery of technological content.*

**Keywords-** Distance education. Teaching with technologies. TPACK. Teaching. Learning.

## I. INTRODUCTION

The use of technologies is a major factor in the teaching and learning processes in Distance Education (DE). For this reason, it is equally important to reflect on the intentional use of technologies in the teaching of certain content. Sometimes, the use of technologies may seem "automatic" or "natural": a forum for discussion, a test for verifying learning. But it is necessary to understand the bases that justify the choice of a forum to provide discussions or a test for the purpose of assessing learning.

In order to discuss it, this article uses the Technological Pedagogical Content Knowledge (TPACK). Developed over the 2000s, especially by Koehler and Mishra [1], the present approach indicates that, for each context that arises, there is a particular fabric between technologies, pedagogical approaches and specific contents of their proper teaching and learning processes of learning [2].

In Brazil, this theoretical approach is little known, even in distance education situations, which, as already mentioned, depend on the use of technology. The same applies to its main data collection instrument, the Survey of Preservice Teachers' Knowledge of Teaching and Technology [3].

In this context, the present paper aims to discuss the data collected in response to the first part of the survey - the one focused on technological knowledge - which was applied to undergraduate students in Chemistry, Physics, Biology, and Mathematics at the Virtual University of São Paulo State (Univesp).

Thus, the present work, after this introduction, will be dedicated to a brief description of the theoretical horizon that guides the research, as well as the methodological procedures adopted and the context of the investigation. Finally, it will

bring the results and analyses, followed by the final considerations.

## II. THE THEORY

In the 1980s, Sulman [4] pointed out that there are two bodies of knowledge required in teaching practice: Pedagogical Knowledge (PK) and Content Knowledge (CK). The former includes knowledge about teaching and learning theories, assessment, classroom management and curriculum, among others related to school life. The latter, in fact, refers to the practical application of knowledge regarding learning, teaching management, planning and application of teaching strategies and assessment.

CK involves specific elements of each area of knowledge, such as arts, philosophy, biology, history, chemistry, geography, physics, sociology, science etc. It refers, then, to the quantity, quality and organization of knowledge of the specific field in the teacher's framework. Because, as Shulman [5] points out, each area of knowledge can present different ways of looking at the structure of knowledge, but in all of them it is necessary to go beyond the pure and simple knowledge of the facts or concepts specific to the field of knowledge [2].

From the growing adoption of technologies in education, this became a factor to be considered and, in the 2000s, Koehler and Mishra [1] were decisive in the definition and dissemination of a knowledge structure that encompassed what was already said by Shulman, more technological aspects. So TPACK incorporates Technological Knowledge (TK) into the initial structure, which refers to the understanding of how technology can be applied in the work or in everyday life,

when it helps and when it does not, and when it is necessary to update yourself in technologies and how to do it.

TPACK, therefore, has to do with a complex body of knowledge that is not restricted to the mere overlap of the three types of knowledge that compose it. It is, in reality, a broad process of interaction between pedagogy, technology and specific contents, as shown in Fig. 1, using teaching and learning with a significant and structured appropriation of technologies [6].

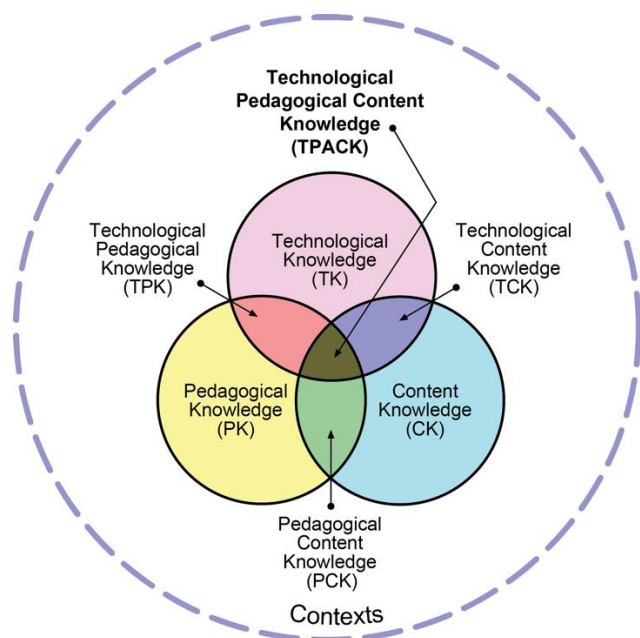


Fig. 1 TPACK theoretical framework

According to Koehler and Mishra [1], in instance, this theoretical model should be thinking of how the concepts of their knowledge area are didactically represented through the use of appropriate technologies and pedagogical strategies that apply technology for effective and significant construction of the knowledge of a given content. All of this must still consider, as the Fig. 1 shows, each context in which the teaching and learning processes take place. Thus, there is no single pedagogical solution valid for any and all situations that arise in the educational context. Each situation that occurs in a classroom or other training space can be solved with its own combination or a joint weave of the elements that make up the TPACK [2].

### III.METHODOLOGY

The data collection procedure for this research was the application of a survey, via Google Forms, with students from the four undergraduate courses (Physics, Chemistry, Biology and Mathematics) at Univesp. This procedure is seen as a set of questions that the informant answers in writing without the need for the researcher's presence [7].

The option for this instrument, applied through the internet, has to do with the need to collect a larger amount of data in a more diagnostic way, and because of the spatial dispersion of the research, considering that Univesp has distributed students supporting center by cities in the São Paulo state. The use of this procedure is supported in the literature regarding TPACK:

surveys and questionnaires have been one of the most applied data collection forms in the last decade of research on the topic [8].

The questions contained in the instrument were developed based on the Survey of Preservice Teachers' Knowledge of Teaching and Technology [3]. In the PhD research process, the questionnaire was translated and adapted to the Brazilian reality and the objectives of this investigation. The final product contained closed questions - with answer options and spaces for marking the choice, whose tabulation is simpler - mixed with others, open - which offer the respondent more freedom of response and tend to return to the researchers richer information, but whose analysis is more difficult and complex, when compared to closed ones [9].

The questionnaire applied to this research contains more than 50 questions, between open and closed ones, and general ones (such as those related to pedagogical or technological knowledge) and the most specific ones (such as those involving the knowledge of students about specific contents). Specific contents). Given the spatial limitation of this work, only those focused on TK will be discussed here. From the scale "I totally disagree", "I disagree", "I neither agree nor disagree", "I agree" and "I totally agree", the following statements were presented to the respondents:

- Statement 1: I can solve problems with technologies;
- Statement 2: I can learn technology easily;
- Statement 3: I can keep up to date with new technologies;
- Statement 4: I like to explore new technologies;
- Statement 5: I know several different technologies; and
- Statement 6: I believe that I have the technical skills necessary to use technology.

An open field was also left for general comments and comments. In the translation and adaptation of the survey, were kept clear language, vocabulary suitable for the public, questions without a suggestion or indication of the desired answer and logical ordering of the questions.

In addition to the quantitative analysis of the closed questions, there is also the analysis of the open question, which followed the precepts of Bardin [10], according to which the collected data must be organized, coded in units of meaning and categorized, before or after the analysis itself, for analysis and inference, in order to provide debate and final problematization of the information obtained.

The survey was applied at Univesp, the fourth public university in the São Paulo State. The institution was created in 2012, with the mission of promoting knowledge as a public good, universalizing access to education and applying innovative methodologies, as well as the intensive use of digital information and communication technologies in teaching contexts and learning.

In its first entrance exam, in 2014, more than three thousand vacancies were made available for the four-year undergraduate courses in Physics, Chemistry, Biology and Mathematics, as well as for the five-year undergraduate courses in Production and Computer Engineering. After this, there were entrance exams in 2016, 2018, 2019 and 2020, which currently culminated in almost 50,000 undergraduate students.

### IV.RESULTS AND DISCUSSION

In view of the theoretical framework adopted and the data collected in the context presented and with the support of the

highlighted methodology, it is possible to proceed the data analysis. The graphics referring to the survey's statements will be presented, one by one, followed by discussions based on the TPACK literature - starting with what appears in Fig. 2, below, which represents the answers to the first survey statement.

All the graphics follow this subtitle: dark blue corresponds to "I totally disagree", orange corresponds to "I disagree", grey corresponds to "I neither agree nor disagree", yellow corresponds to "I agree", and blue corresponds to "I totally agree".

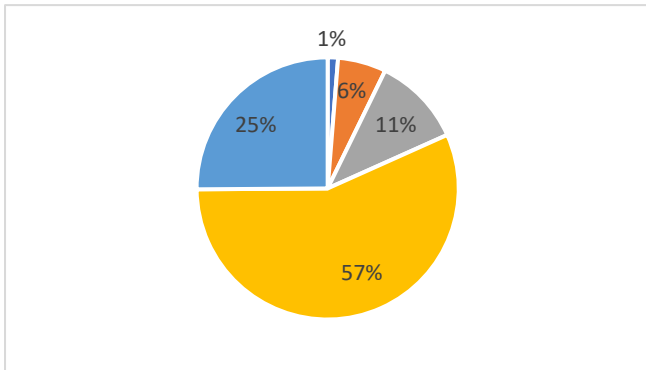


Fig. 2 Answers to statement 1 of the questionnaire

Faced with the statement "I can solve problems with technologies", 82% of respondent graduates indicated that they agree or totally agree - that is, the vast majority are able to deal with their own questions regarding the use of technologies. Considering that they are distance education students, with support of technological appropriation, this is a consistent result - especially if it is taken as this technology as a synonym for digital technologies [11].

In addition, taking the definition of technology openly, as the tools created by human knowledge about how to combine resources to achieve desired products or satisfy their needs - definition initially given by Koehler and Mishra [1] - these numbers make even more meaningful. And they are fundamental for good teaching practice with the support of technologies in teaching specific content.

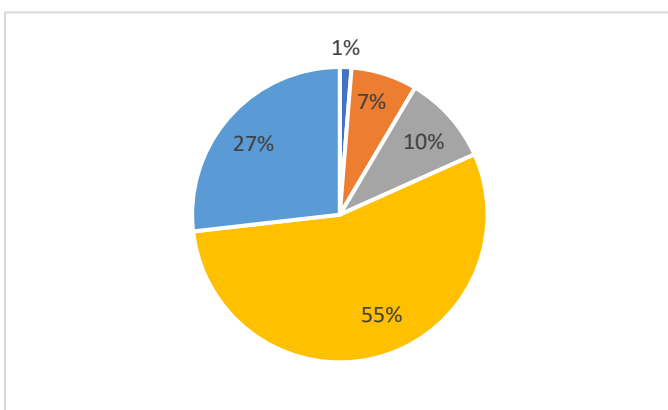


Fig. 3 Answers to statement 2 of the questionnaire

The numbers in the Fig. 3, referring to the statement "I can learn technology easily", do not differ much from the previous one: 82% of those who answered the survey also consider that

they agree or fully agree. This data is also relevant in view of the fact that digital technologies - which the undergraduate students pointed out to be easy to learn - can provide human beings with great skills, competences and powers, allowing them to perform actions that were not possible before [1], including a better teaching.

In this sense, teachers are allowed the conscious appropriation of technology for teaching and learning specific content with the support of technologies [2]. Being able to learn to use technologies with ease is a first step towards conscious, critical and informed adoption in specific educational contexts.

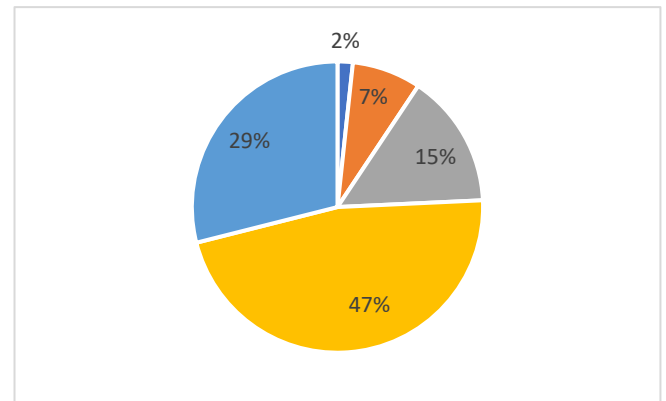


Fig. 4 Answers to statement 3 of the questionnaire

Fig. 4 shows a small drop in the number of respondents who agree or totally agree with the statement 3 ("I can keep up to date with new technologies"): 76%. At the same time, until then, it is the largest number of "I totally agree": almost 30%.

Considering that digital technologies are unstable and change rapidly [2], the ability to keep up to date is fundamental. More than that: it is a fundamental element for the development of teachers' understanding of the possibilities and limitations of the educational use of one technology in comparison with another.

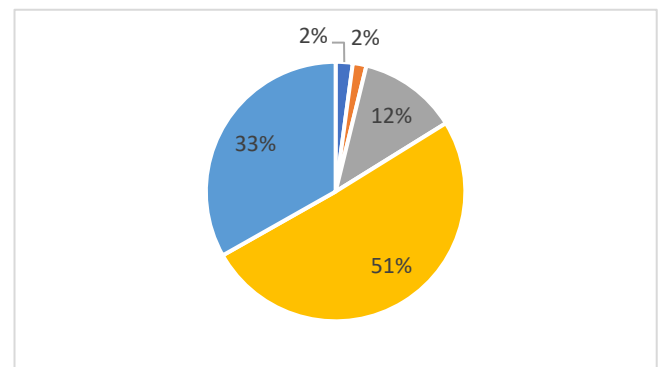


Fig. 5 Answers to statement 4 of the questionnaire

Until this statement, the affirmative responses to "I like to explore new technologies" are the highest: 84%, as can be seen in Fig. 5. And this data is more relevant than the previous one, because "being able to keep up to date" it can take into account factors such as time and devices that the user has; already

“enjoying exploring” refers to the respondent's willingness, willingly, to seek and use new digital technologies.

If the educational system gives the teacher the possibility to research and update, these data indicate that at least 84% would do so of their own free will. And learning to use technologies, as well as integrating them into the curriculum, is not a solid and immutable action. The permanent change of the digital information and communication technologies requires that teachers become eternal learners who, throughout their professional lives, are willing to face ambiguity, frustration and change [1].

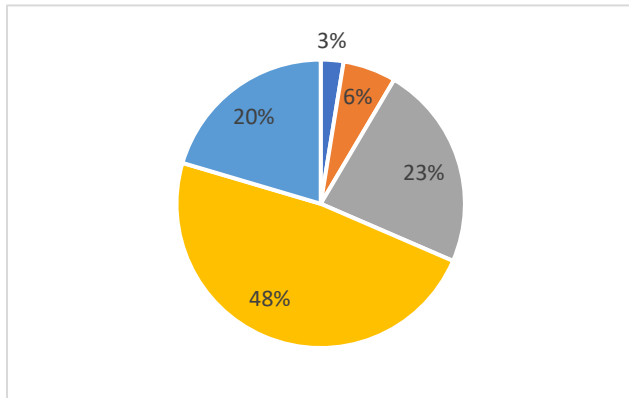


Fig. 6 Answers to statement 5 of the questionnaire

Fig. 6 shows the lowest level of numerical approval in this section of the survey: only 68% said they agree or totally agree with the statement “I know several different technologies”. It is a number that probably demonstrates how much the Brazilian society and, especially, the graduates of the first group of Univesp, have little access to digital technologies, although they want to learn to use them and apply them, as they can see in Fig. 5.

Although the framework authors [1] are very concerned with digital literacy, it can be seen that, in Brazil, there may be an earlier problem: access to technology. And this may be verified, perhaps, in the next generation of teachers, who will leave the degree with less resistance to technologies and with longings to use it.

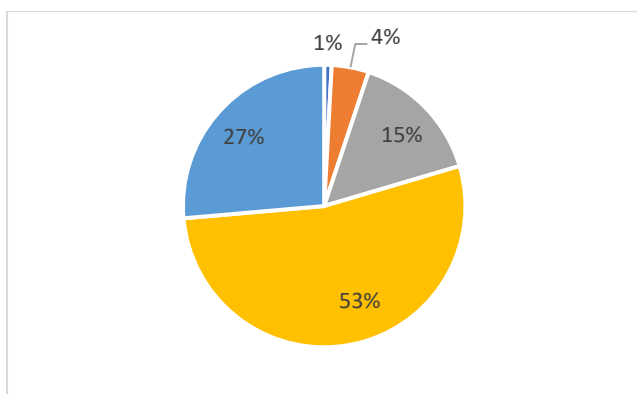


Fig. 7 Answers to statement 6 of the questionnaire

Finally, Fig. 7 shows that 80% of the respondents indicated to agree or totally agree with the statement “I believe I have the necessary technical skills to use technology”. It should be noted that, in this matter, the analysis is only focused on technology, and not on its intentional pedagogical use for teaching and learning certain content.

Regarding the answers to the open question, the main category perceived was that of the respondents who demonstrated that the fact of studying the distance is decisive in improving the mastery of technological content. Some of the answers to this question, in line with the category, are: “My profession, like the university, makes it necessary to live with technology in general” and “Before this course I knew almost nothing about technology; I learned a lot on a daily basis”.

This is a facet not brought up by the TPACK framework, since its emphasis has seemed to be on face-to-face teaching and on how it can appropriate technology in this type of education. In Brazil, there is a marked differentiation between the two modalities, and research on the application and validity of this explanatory model of teaching action is reduced [12].

## V. CONCLUSIONS

In view of the data listed in this work, it is worth resuming the objective initially proposed: to debate the data collected through the TPACK Survey regarding to Technological Knowledge.

In this sense, it is possible to perceive that the translation and adaptation of this part of the survey made sense to the respondents, who informed data according to the research objectives. However, in order to obtain data related to TPACK in distance education, it seems to be necessary to deepen the use of technologies in teaching and learning processes in distance education, whose process of producing and offering teaching materials, for example, differs in Brazil from relevant manner in relation to face-to-face education.

In addition, it is clear that the graduates who answered the survey consider that they have a considerable mastery of the skills focused on Technological Knowledge. It is worth highlighting, especially, how much the respondents enjoyed exploring new technologies, an element that can demonstrate a change in the teaching culture that, in most moments, had shown resistance to the adoption of technologies.

This data contrasts with the statement “I know several different technologies”, which, although it still has a high approval from respondents, has the lowest level of “I agree” or “I totally agree”. This can denote both inequalities in access to technologies, even in the São Paulo State, and the difference in generations, that is, older graduates who, when studying at a distance, see the importance of these tools even without mastering them.

Finally, this last-mentioned factor is demonstrated in the qualitative analysis of the open question. Most of the responses indicate that taking a distance learning degree has made students have more contact with technologies and, therefore, there is an improvement in their level of mastery. It is now necessary to continue a similar analysis of the rest of the questionnaire, in terms of the validity of the translation and adaptation, as well as the responses obtained from the Univesp graduates.

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