



## Effective integration of educational technologies in terms of TPCK framework at technical university

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### Abstract:

The framework of Technological Pedagogical Content Knowledge (TPCK) has been developed as a valuable tool for understanding the ways for effective technology use in the teaching process. Due to continuous innovations in education technologies, educators experience some difficulties how to implement the appropriate technology and correlate it with learning goals, students' needs, content of the subjects and pedagogical strategy. It caused the separation of the educational technology and situational educational process. TPCK framework can bridge the gap and promotes how to combine classical pedagogical strategies and contemporary technologies. This study

focuses on the description and analysis of practical TPCK framework implementation at English Language classes for bachelors at technical university. The paper suggest examples of redesigned learning activities according to TPCK framework concepts in order to enhance students' language skills. The results of the practical implementation observations and students' as well as teachers' reflective blogs demonstrated the benefits and challenges of the approach. Students' feedback evidenced the meaningful impact on their academic achievements and improvement of language competence. Moreover, the described tool can be used as an indicator to assess teachers' knowledge of content, pedagogy and level of digital competence in terms of the professional development.

## 1. Introduction

The concept of information in today's society is decisive. Of particular importance in this context are the ways in which it is used. This is evidenced by the general tendency of active introduction of information technologies in the educational process of higher education. Like any innovation against the backdrop of traditional methods and teaching aids, these new forms need to discuss and reflect on its practical benefits and problems.

Until recently, it was possible to note the dominance of only positive feedback from scientists and educators, who approved the convenience and rich informative and illustrative capabilities of computer technology. However, the excessive desire to modernize education in accordance with the latest technologies can cause some problems of technocratic cognition and learning. This is evidenced by a thorough sociological, philosophical and pedagogical analysis of trends in the development of the information society. Among the problematic issues that require awareness and perspective in the aspect of comprehensive and professional development of the individual is the question how to assess the efficacy of implementation technology into the learning process. It worth mentioning that informational technologies should complement the methods and forms of the educational strategies but not replace them. Using technology alone is not enough to upgrade our teaching process. Technologies are to be well integrated and combined with the content and pedagogical tools. The key idea is not to use technology just for the sake of implementing them but to promote pedagogical strategies and enhance students' content perception.



The modern information environment makes its adjustments to the requirements of the use of multi-media tools in the educational process, the quality and content of which is first and foremost related to the personality of the teacher. According to Norwegian researcher Erickson (2004), the technocratic nature of the living environment causes a sense of fragmentation and loss of control over time and information flow. The teacher does not have time to process large amount of information and to critically comprehend it, which leads to a frame approach to the analysis and transfer of knowledge. And the processes of self-improvement and professional development are turning into a process of constant adaptation to new technologies. Our teachers are overloaded with the digital innovations, that are introduced mostly every month, and in a results educators might be lost in the space of educational technologies.

Among other challenges we encounter while technology incorporation are software is mostly designed with business purposes, not educational ones that leads to mastering the digital competence without acquisition of the educational content; technology developers do not take into account the situational individual nature of the learning environment. Teacher can modify the lesson according the needs of particular students whereas game instructions or options are the same for all students.

Thus, there are some frameworks that help teachers organize the process of technologies integration without losing the sense of educating and redesign the classic teaching strategies into contemporary ones. Our study deals with the application of Technological Pedagogical Content Knowledge (TPCK) framework at the classes of English for Specific Purposes at the technical university.

With this in mind, we identified the **purpose of our descriptive study** as to outline the approach of TPCK framework integration into the teaching process by giving examples of learning activities redesigned in accordance with TPCK framework and to analyze its perspectives and challenges for teachers at tertiary education.

## 2. Theoretical background

A large number of existing studies in the broader literature have examined ways, nature and challenges of TPCK integration. Recent studies have disclosed the issues of insufficient teachers' understanding of how to combine technologies with pedagogy (Graham et al., 2009; Srisawasdi, 2014; Angeli, Valanides, 2018). This idea is supported by Tondeur, Braak, Siddiq, and Scherer (2016) who state that easily accessible educational technologies do not provide teachers with understanding how they should be effectively integrated. They consider that TPCK is a tool to bridge the gap between the pedagogy, content and technologies by suggesting ways how to sensibly select those technologies. Therefore, this issue requires investigation to broaden our understanding of the framework.

Preliminary work in this field focused primarily on the process of matching the pedagogical strategies with affordable specific technologies. Initially the concept of Pedagogical Content Knowledge (PCK) was proposed by Lee Shulman (1986), and later it received seminal and more contemporary revision suggested by Mishra & Koehler (2006). They highlighted the importance of technology incorporation as it allows teachers to design their individual and authentic context-based specific instructions. Researchers pointed out that students' educational products (blogs, videos, online surveys etc.) visualize and personalize the extend of knowledge perception and feedback on the quality of applies learning strategies. Whereas, the authors emphasize that teachers need skills and knowledge how to select and critical assess the efficacy of educational technologies within different content areas.

Many researchers accept the potential and perspectives of TPCK framework. For example, Harris & Hofer (2011) are among those who claim that context specific instructional planning involves the creation of learning activities which can be related to educational technologies. However, the researchers admit that students learning needs and curricular goals should be taken into account while selecting the type of educational technology. Only under this condition the technology supports the activity but not simply replaces it without any functional instructional changes. The efficiency of practical TPCK integration is described in Mercado's et al.(2019) empirical study where they substantiate the approach value in teaching science. The educators state that this approach allows clear knowledge perception by students, experiential teaching instructions planning and enhances teachers digital competence.



TPCK framework nature deals with the educators' perception of how technology can be connected with pedagogy and content. The key idea of the framework is the interrelation of three forms of knowledge content (what to teach), pedagogy (how to teach) and technology (tools and resources) that are not isolated but closely correlate during the educational process. For that reason TPCK discloses the combination of forms as Pedagogical Content Knowledge (pedagogical interpretation of the subject presentation), Technological Content Knowledge (kinds of digital representations), Technological Pedagogical Knowledge (affordance and limitations of technologies, impact on students academic achievements), and Technological Pedagogical Content Knowledge (as a core of the integration process) (Mishra, Koehler (2006). In his recent work Mishra (2019) added the Contextual Knowledge to the framework explaining that this form of knowledge should be a background for the organization of the whole educational process with the implementation of TPCK.

The successful process of technology integration requires from teachers to be self-reflective and be open to ideas suggested by Kurt (2018):

- 1) content should be represented using technology,
- 2) pedagogical techniques transmit content using variety of technology,
- 3) some content concepts might require different skill levels from students due to different educational background, and technology can personalize students' needs as well as teachers' feedback,
- 4) well designed educational technologies collaboration fosters students' educational and personal growth.

With this in mind, we have to notice that teachers also need to update their pedagogical and content knowledge in terms of the professional context in which students will use obtained skills and knowledge. In such case, TPCK is a solution how to stay upgraded and reach learning outcomes in a more contemporary way. TPCK also may be as a measurement of pedagogy and content knowledge as well as an indicator for professional development scale. Having analyzed studies on the topic of TPCK, we can state that the key idea of TPCK is to ensure teachers that successful integration is possible in case if the teaching process is content-driven, pedagogically-sound and technologically-leading.

### 3. Organization of Educational Technologies Integration in terms of TPCK framework

During the planning of the educational process teachers define goals, choose, design, sequence learning activities to comply with the learning outcomes of a lesson or curricular and select tools to support the value of learning activities. In our study we would like to demonstrate the groundwork based on TPCK that will help to organize the integration process. Having analyzed our challenges and mistakes on the way, we have developed some steps with examples of learning activities redesigned in accordance with TPCK framework. Because we believe that if technologies are implemented in a sensible way, they enhance, simplify and adjust pedagogical strategies.

#### (1) Learning outcomes identification

Prior to selecting the technology, we recommend to define the problem or outcome a teacher wants to be focused on as well as students' academic and technology using background. We have to work in difficult conditions with mix ability groups, low motivated students, with poorly developed skills of critical thinking and self-reflection skills. In order to address some of these learning points, technologies can help us gather all necessary information about each student, accumulate information, trace the dynamic of achievements or failures, perform quick, more frequent and more informative assessment, personalize activities, provide more authentic learning environment and global audience to communicate knowledge or educational product. Therefore, before planning we should clearly define the outcome. The next step while planning is to find a technology that will match the goal achievement. The last step is to assess the affordability of the technology, hardware and software specification to ensure the proper use of the technology. Thus, the key point at this stage according to TPCK framework is to define content-related students' educational needs combined with content-oriented learning activities and matching educational technology.



## (2) Planning of the learning process

During this stage it is important to establish the sequence between the goal, learning material and activities. Teachers have to select those technologies that will be useful to the particular students and particular learning activities. For instance, there are a lot of approaches to teach English verbs tenses forms and if a textbook suggests a particular approach to train these forms, software can be based on another approach but both should be aligned with the general outcome of the lesson. While performing grammar tasks from a textbook and performing a digital storytelling through technology, students will not notice that in fact they do the same activities. But it will help us avoid routines and boredom at the lesson. And the most vital at this stage is to be sure that a teacher knows how to use technology and how to deal with possible technical problems that might arise. It is worth noting that the process of technology integration changes teacher's roles too. Thus, now teachers perform roles of an educator, a social facilitator (to create friendly atmosphere for communication), a manager of the educational process and a technician who can solve problems of technical aspects. Teachers also have to check the technology infrastructure quality, and to be able to install browser or software.

Special attention should be paid for the preparation of content-based learning activities. We may differentiate learning activities as multiple content and specific content. Multiple content activities (discussions, presentations, projects etc) can be implemented for different subjects in different content. Whereas specific content activities are only for one specific subject, for example labs, word dictations, calculations etc. Both types of activities should be content oriented and technologies should be pedagogically and contextually suitable. In a such way we ensure the efficiency of technology integration in terms of TPCCK framework.

## (3) Implementation stage

At this stage we execute the plan and monitor the progress. In order to demonstrate the practical examples of technologies integration, we have chosen four activities types that can be suggested for teachers of foreign languages. We have redesigned them in terms of TPCCK framework. These activities are focused on developing language skills: reading, writing, listening and speaking (Table 1). The theoretical background for our activities development is the study that suggests the taxonomy of learning activities developed by Harris and Hofer (2011).

## (4) Evaluation and self-reflection stage

The last stage aims at using performance data to evaluate the results comparing with those classes without technology incorporation and current lessons. We created feedback blogs for students' assessment of suggested innovations where students noted what they enjoyed, did not understand, was hard or not relevant to their background or language level. Most answers were positive, students appreciated a lot our innovations and mentioned that their motivation increased as well as language comprehension. We did not perform pre and post tests to see the difference but we could see positive changes when performed tests or extracurricular activities. The most unexpected comment was about the finding the common "language" with teachers who became experts in technologies and did not restrict students in using mobile of computer devices. At last teachers came into students' learning environment. Among challenges students mentioned accessibility to some technologies, quality of internet connection, not clear instructions in some programs.

The described activities examples dispose TPCCK framework as the basis for shaping instructional pedagogical strategies within an educational environment. There is the ASSURE Model developed by Smaldino et al. (2006) for critical assessment of media, but we adopted it for critical assessment of technology in terms of TPCCK framework:

- Analyze the students needs and background;
- State the learning outcomes;
- Select the technology;
- Utilize the technology;
- Require students engagement and participation;
- Evaluate and revise



**Table 1. TPACK framework for English Language classes**

Content	Pedagogy	Technology
<b>Reading and vocabulary activities</b>		
academic vocabulary and technical terminology awareness	study words patterns, analyze meaning changes depending on the text register, sorting the vocabulary, matching with definitions; stimulate students' thinking about the importance and relationship of words, recalling the meaning of specialized terms	ReadWriteThink, word processing, use-in-a-sentence. Com, Wordle, MindMup, Inspiration, VisualThesaurus
semantic activities, clustering	gain knowledge about words through multiple exposures in different authentic contexts and media	TrackStar, WebQuest
word formation of field-related terminology and social learning	to train word formation rules, differentiate word components, change parts of speech, participate in communities and social good	FreeRice, PrefixSuffix.com
improve technical texts reading comprehension, skimming and scanning skills	practicing reading passages, matching with titles, eliminating unnecessary information, text-to-speech activities, skimming and scanning skills development	Read and Write for Google, Fluency Tutor, media for creating e-books, Newsela
<b>Writing</b>		
semantic mapping	brainstorm ideas for the writing tasks	MindMup, concept mapping software
sequencing and writing organization	knowledge of the text organization, linking words training, clustering, outlining	Essay Punch, Evernote, English Letter Templates, EnglishGrammar Quizz,
writing different types of field-related texts and business letters	awareness of texts and letters types and their structure, register features, useful phrases, grammar points	Digital storytelling, Learn English through Essay Writing, Purdue University Online Writing Lab (OWL), Newspaper Club
writing assessment, revising, editing	journaling, peer review, self-editing, proof-reading	Text Inspector, Grammarly, SubEthaEdit, collaborative writing, blogs,
<b>Listening</b>		
listening skills development	differentiating word patterns, listening for details, true/false information identification	Ello, BBC 6 min English, RealEnglish, IELTS, Cambridge exam preparation resources, online demonstrations and video.
<b>Speaking</b>		
speaking performance	monologues, dialogues production, discussions, expressing different speech patterns according to the speech intent	sound recording tools, podcasts, word clouds generators for discussions, video, Ted Talks, videoconferences, Skype

This model helps to organize the technology implementation in a more convenient and beneficial way. Teachers, who participated in the development and implementation of this approach at the university, also were asked to write their reflection blog with 4 questions to consider:

- 1) How does technology support chosen pedagogical strategy?
- 2) How does it impact learning outcomes achievement?
- 3) What additional skills or knowledge were enhanced apart from language competence?
- 4) What challenges did you experience?

In their reflective blogs teachers admitted that educational technologies greatly impacted the outcomes of learning and increased students engagement into the process of acquiring knowledge. Using technologies





simplified the communication process between students and teachers and this process became more trustful, personalized and productive. Moreover, the range of soft skills developed through technology incorporation considerably extended. Teachers mentioned collaboration skills, team working, community participation, citizenship involvement, critical thinking and creativity development, strengthened the decision making process. Among challenges we identified not enough technology training, poor support from the administration to employ some additional equipment, time consuming process of registration for some platforms or sites, a great variety of technologies to choose the best one so it would be better if in collaboration with teachers from other universities we could create a bank of verified and efficient educational technologies.

## 4. Conclusions

Our study has led us to conclude that collaboration of tools and pedagogy in terms of TPACK framework has enhanced students' content knowledge with practical application and integration of authentic educational technologies. This framework increases students' and teachers' motivation to employ something new, perform experiments and find mutual solutions for new challenges. Moreover, the experience of using educational technologies can lead to extended diversity and creation of new instructional educational strategies in terms of current trend as blended learning. However, we highlight the domination of pedagogy in the process of technology implementation but not wish to try a new technology. Successful integration of educational technologies turns students from passive visitors of classes into active learners who are ready to change and acquire new knowledge even beyond the classrooms due to the endless possibilities of digital technologies that provide learning without the limitation of time and place. Taking into account the principles of the theory of cognitive development, we know that active learning facilitates knowledge acquisition. TPACK framework is in a line with this theory because students get skills through active participation in the learning process. We strongly believe that deploying educational technologies by means of TPACK framework aligned with the best pedagogical strategies, educators have a great opportunity to provide meaningful impact on learners outcomes.

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