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Developing the Techno-pedagogical Skills of Online University Instructors

Vincent Grenon, France Lafleur and Ghislain Samson

Abstract: Online training is rapidly being adopted by universities. It is important to contemplate how to effectively support the development of the techno-pedagogical skills of online instructors, particularly when using a synchronous delivery method. A descriptive research project with a convenience sample of 14 professors and lecturers was used to test a training sequence in using Web conferencing. A one-group, pre-test, post-test, pre-experimental design combining data collection through a questionnaire and observation was implemented. The questionnaire focused on the profile of the participants regarding their use of technology, social media, and cloud computing. Techno-pedagogical skills were observed in 10 simulated situations. Surprisingly, participants whose profile indicated high access to technology and social media did not perform any better than those with less access. The use of several cloud-computing services was conducive to a higher score when observing more inclusive simulated situations. To provide effective support to online instructors, we recommend they be given the necessary training to ensure efficient and effective performance and prepare them for switching from in-class teaching to online instruction while taking all challenges into account.

Keywords*:* techno-pedagogical skills, distance education, training, instructors

Résumé : La formation en ligne est rapidement adoptée par les universités. Il est important d'envisager comment soutenir efficacement le développement des compétences technopédagogiques des enseignants en ligne, en particulier lorsqu'ils utilisent un mode d'enseignement synchrone. Un projet de recherche descriptive avec un échantillon de commodité composé de 14 professeurs et chargés de cours a été utilisé pour tester une séquence de formation à l'utilisation de la conférence Web. Un design pré-expérimental a été étudié en combinant les données récoltées par questionnaires et l'observation d'un groupe dans le cadre d'un pré-test et d'un post-test. Le questionnaire était axé sur le profil des participants en ce qui concerne leur utilisation de la technologie, des médias sociaux et de l'informatique en nuage. Les compétences technopédagogiques ont été observées dans 10 situations simulées. Étonnamment, les participants dont le profil indiquait un accès élevé à la technologie et aux médias sociaux n'ont pas obtenu de meilleurs résultats que ceux dont l'accès était moindre. L'observation des situations plus inclusives simulées ont par contre mis en relief que l'utilisation de plusieurs services d'informatique en nuage semblait aller de pair avec de meilleurs résultats. Afin de fournir un soutien efficace aux enseignants en ligne, nous recommandons qu'ils reçoivent la formation nécessaire afin de mettre en

œuvre un travail efficient et efficace, et de les préparer à passer de l'enseignement en classe à l'enseignement en ligne en prenant en compte tous les défis d'une telle transition.

Mots-clés : compétences technopédagogiques, formation à distance, formation, enseignants

Introduction

The concept of skill development in instructors who provide initial and continuing education in an online university-level setting is not a new issue. However, the rapid evolution of the technology used to provide this type of training (Vachon, 2013) combined with the strong global growth of course offerings (Grenon & Larose, 2017; Lafleur 2019; Abdelli, 2003; CSÉ, 2015; Parr, 2017) brings the training needs of instructors to the forefront. In Quebec, the *Conseil supérieur de l'éducation* reported higher rates of enrollment in distance learning programs; these have increased by 250% since the mid-nineties (CSÉ, 2015). In Canada, the shift toward online training is gaining momentum (Government of Canada, 2018). This strong growth exerts pressure on academic institutions, among which there is strong competition to attract this clientele. New hybrid or fully remote programs are being developed, with varying degrees of access to resources and properly trained faculties. By way of example, between 2009 and 2012, enrollment in this type of program increased by 295% at our host university (CSÉ, 2015). This gives rise to challenges regarding the development of pedagogical activities and training for distance training instructors. We believe it is important to properly plan and organize training for instructors to help them develop the skills required to shift from traditional teaching to distance training. Whilst programs are being developed and enrollment is on the rise, universities still do not necessarily hire specialized and dedicated online training professionals, i.e., individuals trained to face these challenges and ensure the quality of online training. Based on the new courses to be offered online, universities are reorganizing and managing the tasks of instructors who were originally hired to deliver traditional in-class teaching, and who sometimes find it difficult to adapt to the context of online training (Muirhead & Betz, 2002). However, we have also known for a long time that there is no guarantee that the best in-class instructors will have proficiency in the context of distance training without rigorous prior training and preparation (Arah, 2012). We believe this preparation should include technological elements related to the educational tools instructors will use to provide online training, as well as pedagogical concepts to take advantage of new environments and maintain quality standards in online training. In fact, the works of Cyrs (1997) indicate that institutions that do not train their instructors will have lower student enrollment rates in the long term.

There is no consensus on the best training strategies that universities or institutions seeking to shift to distance training should adopt, especially given that institutions are not all at the same level of development. Nonetheless, a few recurrent findings in the scientific literature should be mentioned.

Guasch, Alvarez, & Espasa (2010) identified five different perspectives from which instructors should be trained regarding distance education: (1) design/planning; (2) social; (3) training; (4) technology; and (5) management. The lack of both courses and incentives to pursue training has long been documented (Wolcott, 2003). A survey on university level instructor training by Johnson & Pitcock (2007) revealed that these sessions tend to focus on the platforms or training tools used rather than on how to systematically address the pedagogical issues and challenges instructors will face. These technical or technological courses are not enough to prepare instructors adequately. Technical aspects should not be neglected, but they must be complemented by content related to the pedagogical methods and elements that should be implemented to facilitate interaction, collaboration, and discussion among learners (Barak, 2012). In truth, the challenges online instructors must overcome are not as technical as they may seem (Moore & Anderson, 2003); it's also important to take into consideration the pedagogical aspects (Delfosse, Harmeling, Poumay, & Leclercq, 2003).

Finally, in a context where the training offered in many universities is technical, technological and only short-term in nature, the research question could be formulated as follows: "How can we effectively support the development of techno-pedagogical skills among online instructors?"

Literature Review

The technological and techno-pedagogical skills of online instructors must be developed according to the different teaching methods: synchronous, asynchronous, bimodal, and hybrid or fully remote. According to Bérubé & Poellhuber (2005), techno-pedagogical skills are defined as the ability to use ICT in a pedagogical context. To date, very few studies have taken into account the means used to properly develop the techno-pedagogical skills of instructors (Grenon, Larose, & Bolduc (2019). (Besides, it is still necessary to properly identify the constituent elements of techno-pedagogical skills.)

The scientific literature makes it possible to identify the TPaCK (*Technological Pedagogical and Content Knowledge*) model, developed by Mishra & Koehler (2006), as directly linked to techno-pedagogical skills. According to Karsenti (2018), this model and its current derivatives (Kessler, et al, 2017) are those most often used in studies that call on information and communications technology. The TPaCK has had a major impact on the educational technology research community (Cox & Graham, 2009). This model refers to the relationship between disciplinary, pedagogical, and technological content, and has earned a significant place in conventions for education professionals as well as among university instructors wishing to integrate technology in their teaching. There is an abundance of scientific literature based on this framework, which examined the elements that instructors must know to integrate technology into their practices and how it might impact the subject matter to be taught. Figure 1 shows this model.

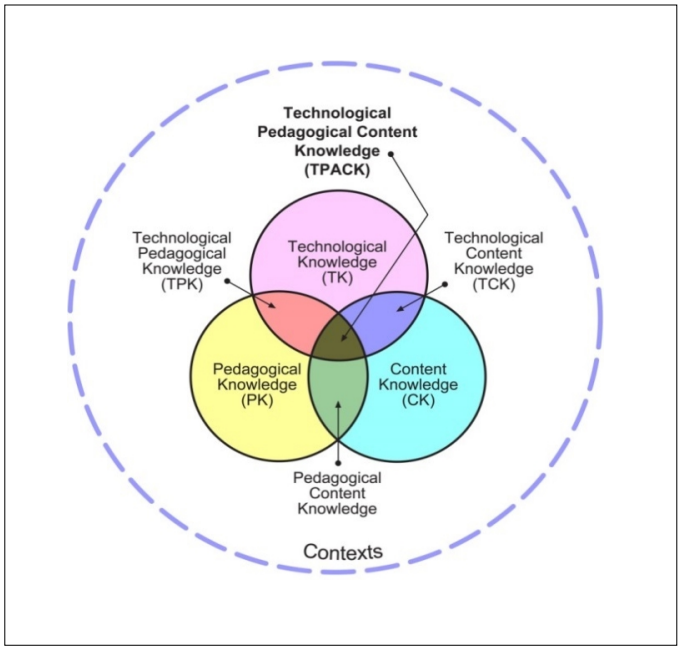

Figure 1: Koehler & Mishra (2009) TPaCK model

This theoretical proposal consists of seven elements stemming from three fields (technological, pedagogical, and disciplinary content) (Mishra, Koehler, & Henriksen, 2011). The author's original definitions follow three main fields:

1. "Content knowledge (CK) is teachers' knowledge about the subject matter to be learned or taught" (Koehler & Mishra, 2009, p. 62).
2. "Pedagogical knowledge (PK) is teachers' deep knowledge about the processes and practices or methods of teaching and learning" (Koehler & Mishra, 2009, p. 63).
3. "Technology knowledge (TK) is always in a state of flux. The definition of TK used in the TPACK framework is close to that of Fluency of Information Technology […] goes beyond traditional notions of computer literacy to require that persons understand information technology broadly enough to apply it productively at work and in their everyday lives, to recognize when information technology can assist or impede the achievement of a goal, and to continually adapt to changes in information technology" (Koehler & Mishra, 2009, p. 64).

Among the four intersections of these fields (PCK, TCK, TPK, and TPaCK), one is directly linked to techno-pedagogical skills. Technological Pedagogical Knowledge (TPK) is defined as:

> … an understanding of how teaching and learning can change when particular technologies are used in particular ways. This includes knowing the pedagogical affordances and constraints of a range of technological tools as they relate to disciplinarily and developmentally appropriate pedagogical designs and strategies" (Koehler & Mishra, 2009, p. 65).

The ability of instructors to grasp the different ways of harnessing technology according to their context of use is particularly important in the fields of educational sciences. In fact, many technologies were not developed specifically for education. Hence, instructors must go beyond conventional uses and adapt them to the pedagogical level. According to Koehler & Mishra (2009) "TPK requires a forward-looking, creative, and open-minded seeking of technology use, not for its own sake but for the sake of advancing student learning and understanding" (p. 66). Therefore, the elements targeted in this intersection exceed the simple use of technology to benefit the learning of trainees.

Several authors, including Loisier (2013), Audet (2009) and OCDE (2015), warn that entirely synchronous training might cause certain difficulties for instructors. Synchronous Web conferencing requires a high level of technological knowledge as well as greater management of interactions among the learners using these tools.

Given that the techno-pedagogical skills of instructors must be developed (Collin, 2016; Gabriel, Campbell, Wiebe, MacDonald & McAuley, 2012), especially when using a synchronous method, and that the TPaCK provides a basis for identifying relevant techno-pedagogical elements (TPK), we set the following objective: Describe the instructors' level of integration of techno-pedagogical skills after receiving training on Web conferencing.

Research Design and Methods

To meet the objective of this study, a descriptive research approach was used (Fortin, 2016). This type of research makes it possible to provide an accurate and detailed picture of a situation based on descriptive statistics. This study does not aim to create causal links between the training and description of the participants' skills. In fact, the low number of participants would not permit that to be done. Thus, we aim to describe techno-pedagogical skill development among university instructors in terms of the use of Web conferencing. The use of descriptive techniques makes it possible to highlight the elements observed within the framework of this study, specifically the effect of independent variables on the development of this skill. The Web conferencing software being studied is known as Via. It was developed by a local Quebec business. It is available in 23 French-speaking academic institutions, mainly located in Canada and Europe.

This research was conducted in fall 2017 in a Quebec university (Université du Québec à Trois-Rivières) that is currently using this Web conferencing software. The surveyed population was comprised of the 455 professors and 819 lecturers currently working at this university. The sample was selected using a non-probability sampling method. Our sample was a convenience sample composed of volunteers registered in courses on this Web conferencing software (Fortin, 2016; Henry, 1990) who have never given distance training or hosted a Web conference. The volunteers had shown interest to invest themselves in distance training but had no experience in this area. In this university,

the courses intended for instructors are offered on a voluntary basis, as is often the case in Quebec universities. In this sense and given its constitution, the convenience sample is representative of ecological validity (Shadish, Cook, & Campbell, 2002). In other words, the volunteer group is typical of volunteer groups found in this type of training. In the end, 14 out of 16 individuals from the group volunteered to participate in this study; nine of whom were professors and five were lecturers. The gender distribution was as follows: 10 women and four men. In terms of university-level teaching experience: five had five years or less of experience, six had between six and 15 years of experience, and three had more than 16 years of experience.

The research protocol that was used for this study was a one-group, pre-test, post-test, pre-experimental design (Cohen, Manion, & Morrison, 2011) in two phases (phase 1 – technical training and phase 2 – techno-pedagogical training on using Web conferencing). This protocol made it possible to identify the influence of these courses on the development of techno-pedagogical skills related to using Web conferencing.

The two courses offered were complementary in nature and in accordance with the principles of Drummond & Sweeney (2017) regarding the importance of moving away from training that is too focused on technological knowledge. The first course followed the traditional basic technical training approach offered in Quebec universities which focuses on the software's functionality. It follows the training offered to new users by the Via Web conferencing service provider. It was comprised of three components related to technological knowledge (TK): 1) introduction to the Via platform; 2) tour of the synchronous collaboration interface; 3) presentation tools. The second course added pedagogical knowledge (PK) inspired by the TPaCK model. Adding pedagogical knowledge (PK) in the second course resulted in an intersection creating the TPaCK model referred to as TPK. This second course, therefore, produced an activity that included techno-pedagogical learning about using the software laid out in four components: 1) managing the digital environment; 2) managing synchronous communications; 3) managing documents, screen sharing, and application windows; 4) managing workshops.

To minimize the risk of bias associated with internal validity, these courses were offered in a short time frame (historical factor biases may affect research) and led by a Via instructor (biases associated with impacts associated with the experimenter). The content of these two courses was validated by a panel of experts in the field to ensure that it matched the elements targeted by this study.

Data was collected through a questionnaire and an observation grid. The questionnaire targeted sociodemographic variables and independent variables linked to the profiles of the participants regarding their use of technology. These variables had the potential to affect the participants' results during the observation phase. Based on the available data (mainly nominal and ordinal categorical

variables), the sample size, and the objectives of this study, data analysis was performed using descriptive statistics (with measures of association and nonparametric statistics). We made use of Cramer's V without correcting any bias since most of our contingency tables used a 2 x 2 format. Therefore, we referred ourselves to Bergsma (2013) which informed us that in these conditions, the performance of the estimator without any correction is comparable). Bias correction estimators would be required for larger contingency tables.

Findings/Results

First, we present the profile of the participants regarding their use of technology and social media. Our analysis found some of these variables to be significant. Table 1 shows the number of participants who indicated using different technologies in a personal (private) setting or in the context of in-class teaching.

Table 1: Use of Technologies in a Personal Setting or in the Context of In-Class Teaching

Types of Technologies	Use of Technologies	
	Personal or Private	In-class Teaching
PowerPoint	11	12
Prezi	1	2
Interactive digital board	2	3
Keynote	2	1
Google Doc	3	4
Google Form	1	2
Doodle	7	2
SurveyMonkey	4	1
Tablet (e.g., iPad)	12	3
Smartphone	12	3
Clickers	2	2
YouTube	10	9

As shown in Table 1, the technologies most often used for personal purposes are, in descending order: PowerPoint, tablets, smartphones, YouTube, and Doodle. Technologies are not used as much for educational purposes; in fact, most respondents only use PowerPoint and YouTube for this. However, there is no significant association between using PowerPoint for personal or teaching purposes (Cramer's V = 0.284; $p = 0.287$). The same observation is true with YouTube (Cramer's V = 0.189; $p = 0.480$). There is no direct relationship between these two contexts, as they are not used by the same participants. Table 2 shows the number of participants who indicated using social media for personal or professional purposes.

Table 2: Use of Social Media

	Context of Use			
Social Media	**Personal or Private**	**Teaching or Research Professional**	**Likelihood Ratio**	**Cramer's V**
Twitter	4	2	5.938 (1); $p = 0.015$	0.645; $p = 0.016$
Facebook	11	9	7.818 (1); $p = 0.005$	0.701; $p = 0.009$
LinkedIn	9	5	5.884 (1); $p = 0.015$	0.556; $p = 0.038$

As shown in Table 2, Facebook was the most widely used social media platform by the participants, followed by LinkedIn, both for personal and professional purposes. The measures of association can be used to see how personal use transfers into a professional teaching or research context. The association is strong (all Cramer's Vs are significant and exceed the 0.5 threshold), meaning that participants who use social media for personal purposes do so in other contexts. Table 3 shows the use of cloud computing or large-file data applications. This type of use may prove useful for Web conferencing and targets knowledge related to file management.

Table 3: Use of Cloud Computing

Cloud Computing Services	Context of Use		Likelihood Ratio	Cramer's V
	Personal or Private	Teaching or Research Professional		
Dropbox	14	13	----	----
OneDrive	3	3	4.027 (1); p = 0.045	0.576; p = 0.031
WeTransfer.com (sending large files)	7	6	5.004 (1); p = 0.025	0.577; p = 0.031

The analysis of Table 3 shows that all participants use Dropbox, making it impossible to calculate association as it is almost a perfect match. Regarding the usage of other cloud computing services, participants using them for personal purposes are the same ones using them for educational or research purposes. The association is strong for both OneDrive (Cramer's V = 0.576; p = 0.031) and WeTransfer (Cramer's V = 0.577; p = 0.031).

After completing both courses, the participants were asked to experience 10 simulated situations using the Via Web conferencing software. These 10 simulations were primarily designed by the VIA instructor and the primary researcher. Afterwards, they were given to a committee composed of experts charged with the task of evaluating the representativeness of the identified situations. In the end, it was important to place the participants in a context (synchronous mode) in which the situations are the most representative of what might be experienced while teaching online. The participants were observed and assessed based on their ability to manage the software and rated on their performance (two evaluators – maximum score of five points per simulated situation).
Table 4 shows the total average score achieved by the participants for all situations (S1 to S10) and, more specifically, for inclusive situations (S8 to S10) with a higher degree of complexity.

Table 4: Descriptive Statistics of Overall Results for all 10 Situations and Situations 8, 9, and 10

	N	Min.	Max.	Average	Standard Deviation	Asymmetry		Kurtosis	
						Stat.	Std. error	Stat.	Std. error
Situations 1 to 10 (Potential score of 10 to 50)	14	30.50	41.00	36.61	3.57	-0.69	0.60	-0.894	1.154
Situations 8, 9, and 10 (Potential score of 3 to 15)	14	8.00	14.00	10.79	1.60	0.03	0.60	0.182	1.154

We observe a two-way mixed effect — absolute agreement ICC of 0.807 between the two evaluators (deemed good according to Koo & Li, 2016) for S1-S10, and of 0.689 (deemed average) for situations S8-S10. The overall performance of participants was good (average score of 3.66 for each situation) following only one technical and one techno-pedagogical training session.

Next, let's try to identify the variables in tables 1, 2, and 3 that may be used to identify participants with the best performance during observations. Apart from sociodemographic variables, only the significant results will be targeted for independent variables.

Among sociodemographic variables, neither gender, status (professor or instructor), or experience seemed to affect performance in both S1-S10 and S8-S10. Among the variables in Table 1, none influenced S1-S10. Only one variable impacted situations S8-S10, i.e., the use of PowerPoint for personal or private purposes. We got a Mann-Whitney U value of 7.500, where $p = 0.050$, which constitutes a significant difference. Participants who use PowerPoint got higher scores (median of 8.64) than those who don't (median = 3.33).

Regarding social media (Table 2), the use of LinkedIn in a professional context resulted in a significant difference for S1-S10. We got a Mann-Whitney U value of 6.500, where $p = 0.032$. Thus, participants who use LinkedIn got lower scores (median of 4.30) than those who don't (median = 9.28). Surprisingly, not using social media had no effect on S8-S10. The only variable with an effect on results for S8-S10 was the personal use of social media to participate in discussion groups. In this

specific case, we got a Mann-Whitney U value of 5.000, where $p = 0.032$. Therefore, participants who use discussion groups got lower scores (median of 6.00) than those who did not (median = 11.25).

When taking into consideration the variables related to cloud computing (Table 3), no significant difference was found when cross-analyzing them with the results of S8-S10. However, by cross-analyzing the results from the ten situations with use of a single cloud computing element or several of them, we obtain a Mann-Whitney U value of 7.500 where $p = 0.033$, which constitutes a significant difference. Participants who use several elements got higher scores (median of 9.56) than those who use only one (median = 4.75).

Discussion, Implications, and Limitations

We aimed to study a Web conferencing training program based on the TPaCK model to better train instructors teaching in an online teaching environment. We can now conclude that synchronous training on Web conferencing that includes techno-pedagogical elements helps support the development of the techno-pedagogical skills of first-time online instructors. Considering these observations, the study participants performed well. However, contrary to what we had anticipated, participants whose profile indicated high use of technologies and social media did not always perform better than those whose profile did not indicate frequent use. While the differences are not statistically significant, the use of cloud computing (several elements) fostered higher scores in more inclusive situations.

A meta-analysis by Wolf (2006) of 300 papers as well as interviews with American experts in the field identified the key factors for the success of online training programs. Programs are successful when the instructors receive official training (mandatory for everyone as opposed to voluntary, as is often the case) and already have technological skills prior to the commencement of the training. Ideally, they would be trained in the system they would be using to teach, would receive constant support from their institution, and should be motivated to work in these new environments. Forcing the hand of instructors who are reluctant to invest effort into distance training is not only useless but, contrary to its purpose, also counterproductive.

Participants in this study were volunteers and willing to take this training. The first course enabled them to develop technological skills before beginning techno-pedagogical training. They were also trained in the Web conferencing system they will be using to deliver online courses. In this regard, many of the key factors for success identified by Wolf (2006) and Audet (2009) were observed.

Although many sources of bias have been controlled to ensure a good level of internal validity, we must admit that participants in this study were volunteers and thus not randomly chosen; only one group was studied, and all participants had the same task. Consequently, this source of bias affects

the external validity of this approach. As such, the results cannot be broadly applied to other samples and we recommend that researchers proceed with caution.

Conclusions

The rapid development of technology, the increasing number of distance training courses offered, and the redefinition of academic missions and the roles entrusted to instructors bring their own set of challenges.

Digital tools are constantly evolving, and continuous training is required to hone the techno-pedagogical skills required for online teaching, which will now require instructors to be highly proficient in this skill.

According to the conclusion of a study on communication with students via distance learning, Racette, Peollhuber, Bourdages-Sylvain et Desjardins (2017) claim that the benefits of videoconferencing can only be realized when care is given to planning these sessions, otherwise, far from helping, these meetings can become unhelpful, frustrating and time-consuming. Indeed, the conduct of teaching disciplinary content online also requires careful planning of the activity while taking into account the techno-pedagogical aspects and not only the technological, disciplinary or pedagogical ones. This study corroborates our previous claims that for digital technologies to be better integrated, teachers and lecturers need support or even training to develop the necessary techno-pedagogical skills required for web conferencing.

We endorse the findings of Barak (2012) who claims that instructors should be encouraged, on a voluntary basis, to take part and invest themselves in courses in distance training. They should receive support through mandatory training to ensure effective performance and preparation to switch from in-class teaching to distance training while taking into account all the challenges involved.

Considering our results and comparing them with previous research, we reiterate, like Lefebvre and Fournier (2014) that training of online instructors appears as an essential dimension of the work which must be pursued. This observation is valid both for the school community in general and for the academic community.

At the conclusion of his online training course *Leaders of Learning*, Elmore (2014) also states that with the advent of digital technologies, one of the main challenge instructors will face will be to provide interactive and dynamic lessons and feedback in real time. For this reason, we state with conviction that developing techno-pedagogical skills in the context of using Web conferencing is a must in this era of digital transformation.

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Authors

Vincent Grenon, Professeur, Faculté d'éducation, Université de Sherbrooke. Email: vincent.grenon@usherbrooke.ca

France Lafleur, Chargée de cours, Département des sciences de l'éducation, Université du Québec à Trois-Rivières. Email: France.Lafleur@uqtr.ca

Ghislain Samson, Doyen de la gestion acad.des affaires professorales, Université du Québec à Trois-Rivières.
Email: Ghislain.Samson@uqtr.ca