

Educational Change - Easy to Say, Hard to Do: Teachers' Perceptions towards Introducing Innovative Teaching Approaches

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Abstract

Keywords:

ICT, techno-pedagogical teaching, 21st century skills, TPACK, questionnaire validation

Computers, communication, and internet technologies have led to significant changes in learning and teaching. The constructivist approach in education puts learners at the center of the teaching process and actively makes them construct their knowledge, developing 21st century skills required for tomorrow's world. Despite advances in the process of integrating technology into teaching, a significant gap still exists between promise and actual reality. Implementation of computer technologies depends on many complex factors, one of which is teachers' perceptions of assimilating computerization into their teaching methods. This research is part of a broader study examining techno-pedagogical change in a high school in Israel. The current study focuses on the process of constructing, testing, and validating a questionnaire examining teachers' attitudes toward pedagogical innovation and assimilating technological skills into teaching. The validation process was done by an exploratory factor analysis to detect cases with low variability and explore the dimensionality of each survey instrument. This was complemented by a confirmatory phase. The results showed high reliability and stable dimensions in the instruments.

This study's importance is in constructing an original instrument that examines the extent to which high school teachers adopt innovative pedagogies assimilating technological tools. This study may have a universal contribution because the instrument can be used across countries and cultures.

Zusammenfassung

Schlüsselworte:

ICT, Techno-pädagogischer Unterricht, Kompetenzen des 21. Jahrhunderts, TPACK, Fragebogenvalidierung

Computer, Kommunikations- und Internettechnologien haben zu bedeutsamen Veränderungen des Lernens und Lehrens geführt. Der konstruktivistische Ansatz des Lehrens stellt die Lernenden in das Zentrum des Lehrprozesses und veranlasst sie aktiv dazu, Wissen zu erwerben, und die Kompetenzen des 21. Jahrhunderts zu erlangen, die für die Anforderungen der Welt von morgen von Nöten sind. Trotz der Fortschritte im Prozess der Integration von Technologie in den Unterricht besteht nach wie vor eine erhebliche Kluft zwischen Prognose und Realität. Die Implementierung von Computertechnologie hängt von vielen komplexen Faktoren ab, einer davon ist die Einstellung der Lehrenden, die Computerisierung in Lehrmethoden zu integrieren. Diese Studie ist Teil eines umfassenderen Projektes, das den techno-pädagogischen Wandel an einer israelischen Sekundarstufe 2 untersucht.

Diese Studie fokussiert sich auf den Prozess des Konstruierens, Testens, und Validierens eines Fragebogens, der die Einstellung Lehrender bezüglich pädagogischer Innovation und Assimilierung technologischer Kompetenzen in den Unterricht untersucht. Die Validierung erfolgte durch eine explorative Faktorenanalyse um Items mit geringer Variabilität zu erkennen, und die Dimensionen jedes Erhebungsinstruments zu untersuchen. Ergänzt wurde die Analyse durch eine Validierungsphase. Die Ergebnisse zeigen eine hohe Reliabilität und stabile Dimensionen der Instrumente.

Die Relevanz der Studie liegt in der Entwicklung eines innovativen Instruments das untersucht, in welchem Umfang Lehrende der Sekundarstufe II technologische Hilfsmittel in innovative pädagogische Strategien integrieren. Die Studie kann einen universellen Beitrag leisten, da das Instrument Länder- und Kulturübergreifend eingesetzt werden kann.

1. Introduction

The technological changes that characterize the digital age present challenges to the educational system, which must adapt learning programs and teaching strategies to these new technologies. Schools are required to create a

change process in the school's learning culture in line with the shifting reality (Anderson & Maninger, 2007; Avidov-Ungar & Eshet Alkalai, 2011). Therefore, the Israeli Ministry of Education is leading pioneering projects and

implementing the National Information and Communications Technology (ICT) Program for "Adjusting the Education System to the 21st Century", whose aim is to advance digital learning in Israeli schools.

Despite the stated policy of pedagogical change via ICT integration, many teachers still do not consider these technologies an inherent part of their teaching discipline and continue to teach in the traditional manner (Avidov-Ungar, 2011; Shamir-Inbal & Blau, 2017). The current study is part of broader research that examines high school teachers' attitudes and perceptions towards adopting techno-pedagogical methods. In this study, an original questionnaire was constructed and validated to examine teachers' attitudes and perceptions towards techno-pedagogical approaches and the integration of ICT in their area of teaching according to the following dimensions: desired teacher character, teacher's pedagogical competence, 21st century skills, and school's role in the process of change. Examining teacher's attitudes will make it easier to assimilate the optimal and innovative pedagogy, which will prepare students for the real world that awaits them.

1.1 Educational change and 21st century skills

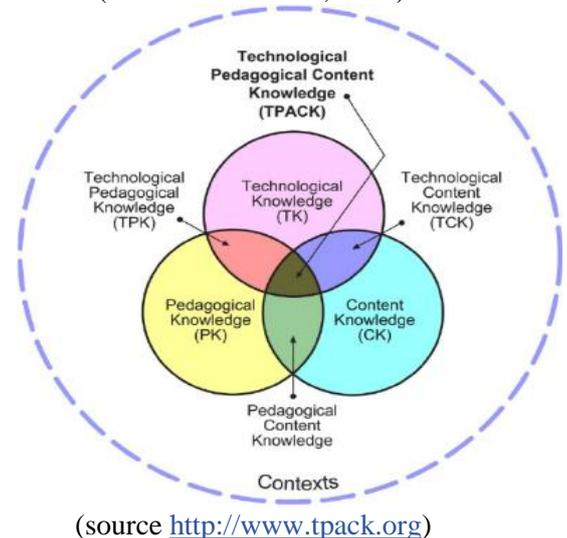
Since the beginning of the previous century, education systems around the world have faced challenges surrounding the argument between two relevant options: "teacher-centered learning", where the learner is a consumer of knowledge, or "learner-centered pedagogy", where the learner is the constructor of knowledge (Dori et al., 2003; Fullan, 2001; McDermott, 1991; Sandholtz, Ringstaff, & Dwyer, 1997). In recent decades, ICT influenced numerous perspectives in society and culture (Bonk, 2009; Pesig, 2010), which necessitated a re-adaptation in numerous areas, including in the education system, where the change is needed primarily in the teacher's role. The teacher must be responsible for the students' learning processes (Cuban, Kirkpatrick, & Peck, 2001; Webster & Murphy, 2008) and teach them how to successfully cope with frequent changes in information, technology, and roles. To do so, the teacher must give up on the role of being "omnipotent".

It is necessary for the education system to adapt to the 21st century (Tondeur, Van Braak, Ertmer, & Ottenbreit-Leftwich, 2017). Schools must recognize the world of today's youth and help students acquire the skills that will be needed to successfully contend with their anticipated challenges. Six categories of essential skills have been identified for successful functioning in the age of knowledge: creativity and ingenuity, critical thinking and problem-solving, ability to communicate and cooperate, information literacy, communication literacy, and computer and technology literacy (Salpeter, 2003).

To successfully help students acquire these skills, there is a need to alter teaching approaches and the teacher's role from one where the teacher conveys information to the

students – "sage on the stage," to one where the student is the center, and the teacher serves as a mentor encouraging independent learning or in partnership with the students – "guide on the side" (King, 1993). Using digital tools and adapting them to the classroom, it is possible to change the teacher's teaching methods and help the teacher develop "digital intelligence" (Prensky, 2009). Integration between technology, pedagogy, and content knowledge (TPACK - see Figure 1) will allow innovative teaching and learning processes appropriate for the education system in the 21st century and improve the learning experience (Hsu, 2016; Luterbach & Brown, 2011). Changes in teaching methods and the teacher's role, and moving responsibility to the students will only happen to the extent that teachers will be convinced that there is a need (Johnson, 2008; Mishra & Koehler, 2009; Washuk, 2011).

Figure 3 Technological Pedagogical Content Knowledge (Koehler & Mishra, 2008)



1.2 Teachers attitudes and barriers towards innovative teaching using technological tools

One of the decisive factors in the effectiveness of adapting innovative technology in school and successful implementation of pedagogical change is the teacher's skills and beliefs as a professional agent with content, pedagogical, and technological knowledge (Borko, 2004; Brinkerhoff, 2006). Teachers' attitudes towards digital surroundings and their role in teaching in these environments can significantly impact how they integrate ICT when teaching (Cunningham, 2009; Halverson & Smith, 2010; Selwyn, 2010).

Two types of internal and external barriers prevent teachers from assimilating technology into their teaching (Avidov-Ungar & Amir, 2018). The external barriers include equipment, hardware, and software resources, technical support, the school's culture, teaching subject, and the teacher's technical skills. Internal barriers include teachers' beliefs in technology and its added value to learning, and their beliefs regarding quality teaching

processes (Hew & Brush, 2007; Hsu, 2016; Nikolopoulou & Gialamas, 2016). An additional barrier is the "disciplinary barrier", reflecting a lack of deep understanding that technological tools can explicitly promote the discipline (Avidov-Ungar & Amir, 2018). About a decade ago, it was found that the more significant barrier preventing the integration of technology is the external barrier, which is reflected mainly in the lack of necessary financial resources (Ertmer, Ottenbreit-Leftwich, Sadik, Sendurur, & Sendurur, 2012; Hew & Brush, 2007).

In recent years, schools have increased access to quality technical resources, and accordingly, teachers have greater control over ICT tools. Nonetheless, teachers are reluctant to integrate this technology into their teaching (Ertmer et al., 2012). Teachers' motivation and attitudes towards the importance of this integration and their ability to do so are directly related to their actual practices (Greer, Koran, & White, 2016; Hsu, 2016; Liu, Lin, Zhang, & Zheng, 2017; Tondeur et al., 2017). Yet, it is not enough for teachers to have positive attitudes towards technology to successfully integrate technology into teaching. Proper training for teachers can bring a change in the quality of teaching and facilitate an intelligent integration of technology into teaching (Davis & Varma, 2008; Furman-Shaharabani & Tal, 2008; Halverson & Smith, 2010; Magen-Nagar & Peled, 2013; Varma, Husic, & Linn, 2008). Teachers need to be trained to adopt new technology by focusing on new teaching skills that are based on the interaction between content knowledge (CK), pedagogical knowledge (PK), and technological knowledge (TK) (Mishra & Koehler, 2006). Salomon (2000) adds that for ICT to support teaching and learning processes, it is important to define a guiding rational pedagogy, which will accompany the way of using the technology. Similarly, there needs to be meaningful and long-term guidance that includes relevant pedagogical advice and experience implementing technology in the class (Davis & Varma, 2008; Furman-Shaharabani & Tal, 2008; Varma et al., 2008).

Implementation of innovative technologies in schools also requires a systematic change in the school culture, including administrative, pedagogical, and technological factors (Coffman, 2009; Eshet, 2007). The school needs to develop an organizational learning culture that helps strengthen the dissemination of knowledge, creativity, flexibility, and support, which are critical ineffective coping with change (Collinson, 2010; Giles & Hargreaves, 2006; Weldy & Gillis, 2010; Zhao & Ordóñez de Pablos, 2009). Similarly, teacher participation in leading change and decision making is necessary to strengthen their positive approach towards change (Davis & Varma, 2008; Fullan, 2014; Harris & Hofer, 2009; Selwyn, 2010). Teachers involved can better contend with the challenge of change and develop professionally (Janson & Janson, 2009; King & Dunham, 2005). As part of this, the teacher has to be surrounded by a supportive learning environment and school system that is part of the school's vision (Bowyer,

Gerard, & Marx, 2008; Fullan, 2006; Furman-Shaharabani & Tal, 2008; Guskey, 1998; Rogers, 2010).

2. Problem Statement

Today's generation of learners has changed to a great extent, and the main goal of education is to prepare students for future job opportunities and civic responsibilities. In Israel, 21st century skills become a significant topic on the agenda of the educational system. In introducing Information and Communication Technologies (ICT) and pioneering programs into schools, the expectation was that teachers would apply constructivism practices into their teaching. However, teachers still do not implement ICT as an inherent part of their teaching discipline. Studies showed that most teachers use technology to implement a traditional "teaching" pedagogy (Avidov-Ungar, 2011; Mioduser & Nachmias, 2002; Shamir-Inbal & Blau, 2017; Steiner & Mendelovitch, 2017). The problem seems to be more difficult in high schools. Until now, no studies were conducted in Israel concerning high school teachers. The construction of an instrument that can evaluate high school teachers' attitudes, perceptions, and willingness to change and implement techno-pedagogical approaches can help understand teachers' needs and promote innovative teaching approaches.

3. Research Question

To what extent the constructed questionnaire is reliable and statistically valid?

4. Purpose of the Study

The study aims to construct an original questionnaire that examines teachers' attitudes and perceptions towards the insertion of innovative techno-pedagogical approaches into their teaching and validate its reliability.

5. Research Methods

The current study utilized a mixed methods approach, including both quantitative and qualitative methods. The study employs a qualitative methodology, which includes 12 in-depth semi-structured interviews as a method of researching the phenomenon and constructing an original questionnaire. Since no questionnaire was found to suit the specific research questions regarding Israeli high school teachers' attitudes and perceptions towards innovative techno-pedagogical approaches and 21st century skills, there was a need to construct a new, tailor-made questionnaire. This study focuses on constructing and validating the questionnaire.

5.1 Research participants

The study participants included 85 teachers of varying disciplines, gender, and years of experience from three high schools that are part of the Amal school network. This network, established in 1928, includes 120 educational institutions, from junior high schools and above. These

schools focus on the sciences, technology, and the arts and are guided by innovation and entrepreneurship (www.amalnet.k12.il/english).

5.2 Research tool

A questionnaire-based on content analysis according to themes and categories of the in-depth interviews, along with theoretical ground and previous research, was constructed. The interviews enabled the researcher to become familiar with the teachers' perceptions of the aspects that promote and inhibit techno-pedagogical change and propose items for the scales to measure these aspects in the quantitative questionnaire. The four main themes identified served as the questionnaire factor dimensions. The four factor dimensions were: desired teacher characteristics, teachers' pedagogical competence, 21st century skills, and school's role in the process of change.

5.3 Process of constructing the questionnaire

The pioneering survey was conducted as soon as the survey questionnaire was constructed. A validation process means that the researcher distributes a valid and reliable questionnaire among the sampled population. Valid questionnaires receive stable responses, have low rates of missing data, and are later easy to analyze, as respondents understand the questions and do not need further clarification. The current questionnaire was composed of several survey instruments designed to assess teachers' agreement with major statements about necessary teaching skills and how they are implemented in the teaching process.

A **preliminary pilot questionnaire** was distributed among 15 teachers to decide upon the style of questions. Two styles were tested: self-evaluation across a set of teaching statements (seven teachers), and an agreement with similar statements, yet about the other teachers (eight teachers). The comparison between the two styles suggested that agreement with other teachers' characteristics had a stronger potential to identify what teachers think. With the limitation of this style, it will still yield good measures of teachers' and teaching aspects. Adjustments were made to the final version of the survey.

Next, it was sampled in a **limited exploratory survey** of 85 teachers for construct validation. In the validation procedure, first, a descriptive statistics and an exploratory factor analysis (EFA) were used to detect cases with low variability and explore the dimensionality of each survey instrument. The EFA procedure determines possible context divisions of the instrument. That is, the survey instrument can be divided into several distinguished sub-contexts, altogether providing full contextual coverage of the theoretical construct. Statistically, it was expected that items from the same instrument share a common context based on correlations. After the final definition of the survey instrument sub-divisions, the Cronbach's Alpha for internal consistency was calculated. This index emphasizes

the internal consistency across factor items. The Cronbach's Alpha provides a measure for consistency across items, especially if these items share the same theoretical context. Alpha greater than 0.70 is considered to indicate a high level of consistency.

Next, **the exploratory phase was complemented by a confirmatory phase** (Confirmatory Factor Analysis, CFA). This phase is intended to validate theoretical constructs. The confirmatory phase is based on goodness of fit statistics for construct validity, e.g., Comparative Fit Index (CFI) and Tucker Lewis Index (TLI). Root Mean Square Error of Approximation (RMSEA) and Standardized Root Mean Square Residual (SRMR). These indices represent the quality of the fit between hypothesized constructs and empirical covariance structures. Commonly, minimum accepted levels for these indices are as follows: CFI, TLI > .90, RMSEA < .08, SRMR < .05 (Wang & Wang, 2012). To summarize, the validation process means that empirical data are aligned with the theoretical framework within which the research is situated. SPSS V.25 statistical package (IBM Corp, 2017) was used for the exploratory phase, and Mplus V.8.0 (Muthén & Muthén, 2017) was used for the confirmatory phase.

6. Findings

For each survey instrument (Main factor), the explored factor structure (factor dimensions), factor loadings, and the overall confirmatory goodness of fit results are presented. The exploratory analysis goal is to determine factor dimensions, which are distinguishable sub-factors that altogether present the survey instrument (Hefetz & Liberman, 2017). The following are the sub-factors or factor dimensions of each survey instrument. These distinguishable factors are shown in Table 1 by means of item loadings, factor statistics, and internal consistency.

There are **four factor dimensions** in the survey:

- a. Desired teacher characteristics
- b. Teachers' pedagogical competence
- c. 21st Century skills
- d. School's role in the process of change

Note that for each dimension, only those items that perform high loadings (Loading > .35) are presented.

The desired teacher: The first instrument looks at the desired characteristics of the desirable teacher. For this purpose, the survey instrument was designed to suggest several statements about teachers and their teaching performances and to ask the surveyed teachers about their agreement level with each statement. Table 1 shows the exploratory analysis results for one factor, including six survey items, while Q1 and Q2 were left as two independent items that did not correlate with the general factor of the desired teacher characteristics. This explored factor was found to explain 45 percent of the common item variance. A further consistency analysis showed Cronbach's alpha of $\alpha = .75$. Although the factor loadings were not extremely high, they were found to be on average, but not very low.

The confirmatory results suggest that the factor structure was confirmed; that is, fit indices are above accepted levels: CFI = .996, TLI = .993, RMSEA = .02.

Teachers' pedagogical competence: A set of questionnaire items (9 to 47) was designed to capture the perceived innovative teacher in terms of pedagogical competence. Table 1 shows the exploratory division for factor dimensions, supported by the confirmatory results. Four distinguished dimensions were found for the pedagogical competence: creativity through interactivity; teachers' originality and innovativeness; self-disciplined learning; and transferring responsibility. This instrument's four dimensions explained over 50% of the common variance, with high reliability across the first three dimensions. The fourth dimension was constructed of only two items, thus the low consistency. A measurement model that included the four dimensions performed to a satisfactory level, as shown in Table 1, e.g., CFI, TLI >.90. For modeling purposes, the fourth dimension may be used as two single items rather than a combined factor.

21st century skills: Next, the items regarding necessary teaching skills for dealing with the 21st century demands were explored. This instrument searched for those skills

that teachers may need if they intend to face technological challenges. Although several items received high agreement as necessary 21st century teaching skills, other items received a lower level of agreement, e.g., "Teachers integrate creative experiences into learning ...". These items were summarized into three dimensions: empowering teachers, self-directed learning, and strategic learning. The three dimensions were found to explain nearly 60% of the common variance, and the reliability was high, which suggests clear and easy to distinguish factors.

School's role in the process of change: The last instrument analyzed focused on the process of change, which is known to be difficult to apply in organizations. Two dimensions were found for this purpose: school empowering the teachers and objective-oriented school. The first factor is shown to explain the instrument's main portion (66%), which is an identification problem to some extent. The data indicated one factor; however, the context required a division into two independent dimensions. Further construct validity test showed a high goodness of fit. Thus, the two dimensions were kept as fully distinguished.

Table 1 Exploratory factor analysis results by factor dimensions: Factor items, loadings, descriptive and consistency

	Desired teacher characteristics	Teachers' pedagogical competence	21st century skills	Schools' role in the process of change
	Factor 1: Desired teacher characteristics	Factor 1: Creativity through interactivity	Factor 1: Empowering teachers	Factor 1: Empowering school
	q3 0.68	q17 1.08	q61 0.90	q75 0.96
	q4 0.64	q12 0.93	q51 0.89	q78 0.87
	q5 0.63	q16 0.92	q62 0.88	q74 0.86
	q6 0.60	q13 0.92	q59 0.82	q77 0.83
	q7 0.53	q18 0.91	q58 0.75	q76 0.78
	q8 0.42	q20 0.72	q52 0.73	q79 0.71
		q19 0.69	q50 0.69	q85 0.46
		q9 0.63	q53 0.69	
		q14 0.59	q60 0.67	
		q46 0.57	q56 0.57	
		q21 0.54	q54 0.55	
		q22 0.46	q67 0.50	
		q15 0.45	q63 0.49	
		q37 0.43	q68 0.42	
		q42 0.40	q69 0.38	
		q11 0.39	q55 0.32	
			q66 0.26	
Eigenvalue	2.72	16.48	13.00	8.00
% of Variance	45.4	42.3	50.0	66.6
Reliability	.75	.95	.95	.94
Means	4.49	3.46	3.78	3.52
SD	0.42	0.72	0.67	0.91
		Factor 2:	Factor 2:	Factor 2:

		Teachers' originality and innovativeness q39 0.84 q25 0.80 q38 0.79 q40 0.73 q28 0.62 q30 0.59 q27 0.57 q24 0.57 q29 0.55 q10 0.54 q41 0.46 q34 0.45 q45 0.42 q43 0.42 q33 0.39 q23 0.39 q26 0.37	Self-directed learning q71 0.81 q65 0.76 q72 0.71 q73 0.66 q64 0.62 q70 0.48	Objective-oriented school q84 0.89 q80 0.86 q83 0.63 q82 0.58 q81 0.52
Eigenvalue		2.24	1.12	0.56
% of Variance		5.7	4.3	4.7
Reliability		.94	.86	.92
Means		3.21	3.16	3.76
SD		0.71	0.77	0.85
		Factor 3: Self-disciplined learning q36 0.69 q31 0.68 q47 0.67 q35 0.46	Factor 3: Strategic learning q49 0.84 q48 0.79 q57 0.39	
Eigenvalue		1.43	0.67	
% of Variance		3.7	2.6	
Reliability		.71	.79	
Means		3.88	3.39	
SD		0.60	0.77	
		Factor 4: Transferring responsibility q32 0.72 q44 0.51		
Eigenvalue		1.29		
% of Variance		3.3		
Reliability		.39		
Means		3.64		
SD		0.62		
Confirmatory Factor Analysis – Goodness-of-fit			First Order Second Order	
χ^2	9.31	771.26	361.71 349.78	51.77

df	9	586	281	280	38
P	.41	<.001	<.001	<.01	.07
RMSEA	.020	.061	.058	.054	.065
SRMR	.043	.069	.053	.053	.030
CFI	.996	.921	.947	.954	.987
TLI	.993	.910	.939	.947	.977

Note: In each cell, the left column is for the item code, the right column is for the item loading on the factor; factor descriptive and consistency are at the bottom of each cell.

7. Conclusions

This study aimed to develop and validate a questionnaire that asks teachers about their teaching perspectives within an innovative rapid technological transformation environment. The validation process exposes the full dimensionality of these perspectives. The empirical exploration of the data reveals sub-contexts within each general perspective and allows a better understanding of teachers' emphases when facing the challenges of implementing advanced technology. The challenge is in preparing teachers for the 21st century so that they can, in turn, prepare their students properly.

The exploration and validation of the first round of answers to the questionnaire teach us about differences between creativity and originality and between teachers' empowerment and school empowerment. Although these aspects exist in the questionnaire items, the factor structures tell us how to distinguish between dimensions and results in a workable questionnaire.

It can be concluded that from two aspects, the questionnaire performed as expected. First, the questionnaire was found reliable by means of Cronbach's alpha. The alpha is a measurement of consistency across items of which the survey instrument was composed. When these reliability values are high, in this study they were found above .70 except one dimension, it indicates the high correlation between these items. High correlation may be interpreted as sharing the same context.

In validity terms, we receive construct validity, which is based on the difference between the observed and the expected relationships across items. When these differences are small, it can be concluded that empirical data measure the expected theoretical constructs. Altogether, the questionnaire in its final form is qualified for use among other educational systems in different countries and across different cultures.

This research's methodological contribution is in constructing a new valid and reliable instrument for examining educators' perceptions towards implementing techno-pedagogical skills in their classrooms. This research instrument can serve as a basis for more studies in the field of teaching and 21st century skills.

This study is a part of a more comprehensive study conducted in Israel. It uses the questionnaire with a large

sample of participants in an experimental group and a control group to examine high school teachers' attitudes and perceptions towards implementing techno-pedagogical teaching approaches.

Authors note: The authors have equal contributions to this article.

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