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# VALIDATION OF THEORETICAL CONSTRUCTS TOWARD SUITABILITY OF EDUCATIONAL SOFTWARE FOR CHEMISTRY EDUCATION: DIFFERENCES BETWEEN USERS AND NONUSERS

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**Abstract.** *The aim of this research was to empirically validate constructs for evaluation of teachers' attitudes toward usage of educational software in chemistry teaching. Questionnaire with items transformed from UTAUT (Unified theory of acceptance and use of technology) and other technology acceptance theories were filled in by 556 Czech chemistry teachers. All constructs passed recommended .7 thresholds of Cronbach's alpha so they can be used in acceptability researches before and after introduction of educational software or building models. However, analyses of effect sizes show that there are not only differences between users and all nonusers generally, but also prove differences between various types of nonusers. Nonusers were established as a) those who had used educational software and abandoned it; b) those who do not use educational software, but are planning to use it in the future, and c) those who do not use educational software and have no intentions to use it. An unexpected finding reveals that differences among subgroups of nonusers can be even larger than between users and nonusers, especially the group c) is an outstanding group. Consequently, factors and their influence on the acceptance and use of educational software in chemistry teaching should be explored for each group separately.*

**Keywords:** *chemistry education, education software, technology acceptance.*

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## Introduction

Information and communication technologies (ICT) are significantly changing methods and content of education (Januszewski & Molenda, 2008; Oliver, 2002). The question of utilization of ICT´s potential in education is considered in many researches. Some of them target integration of ICT generally (e.g. Bingimlas, 2009; Pelgrum, 2001; Wang, 2008), and the others target integration of various technologies and applications particularly. Among the others, technologies such as interactive whiteboards were considered (Slay, Siebörger, & Hodgkinson-Williams, 2008; Smith, Higgins, Wall, & Miller, 2005) as well as mobile technologies (Martin & Ertzberger, 2013; Motiwalla, 2007; Rau, Gao, & Wu, 2008), 3D printing (Kostakis, Niaros, & Giotitsas, 2015), virtual reality (Merchant, Goetz, Cifuentes, Keeney-Kennicutt, & Davis, 2014), and data acquisition systems (Milner-Bolotin, 2012). The other stream of researches is concentrated on attitudes, opinions and believes of teachers and students toward application of various technologies in education (Hennessy, Ruthven, & Brindley, 2005; Prestridge, 2012; Slabin, 2013; Šumak & Šorgo, 2016; Šumak, Pušnik, Heričko, & Šorgo, 2017; Türel & Johnson, 2012; Záhorec, Hašková, & Bílek, 2014). This research is focusing on educational software as tools delivering educational content (see the definition below).

Implementation of ICT into education brings a promise of improving instruction and can encourage positive attitude towards chemistry, which is relatively unpopular among pupils in the Czech Republic (Kubiatko, Balatova, Fancovicova, & Prokop, 2017). It definitely depends on teachers if this potential is fully developed (Mishra & Koehler, 2006; Niederhauser & Stoddart, 2001). The same also applies to educational software: without teachers' acceptance and classroom application of educational software, its potential cannot be fully developed (Chroustová, Bílek, & Šorgo, 2015). However, with rapid development of ICT and exponential growth of number

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of available applications, teachers experience new workloads and responsibilities because they have become responsible for selecting appropriate software and reaching competencies for reasonable utilization of educational software (Yucel & Cevik, 2010).

In this research, factors affecting the use and acceptance of educational software are validated. Constructs affecting the use and acceptance of educational software were adopted mainly from Unified Theory of Acceptance and Use of Technology (UTAUT; Venkatesh, Morris, Davis, & Davis, 2003). The present research was commenced due to the fact that in the Czech Republic the acceptance and usage of educational software in specific educational context were not explored thoroughly (Chroustová et al., 2015).

### *Educational Software*

*Educational* (or *instructional*[1]) *software* (hereafter ES) is predetermined for teaching and self-learning by using educational technology, and is often defined as technology with learning as the end product (Januszewski & Molenda, 2008, p.15). In such a way, it is distinguished from many non-educational aspects of the use of technology in education, such as office software, presentation tools, data acquisition systems, etc. In science education ES is referred to as the use of drill and practice software (Kuiper & de Pater-Sneep, 2014), tutorial software (Kara & Yeşilyurt, 2008), problem-solving software (Funkhouser & Richard Dennis, 1992), computer educational games (Moreno-Ger, Burgos, Martínez-Ortiz, Sierra, & Fernández-Manjón, 2008), or instructional games (Huang, Johnson, & Han, 2013), interactive textbooks (Viau & Larivée, 1993), simulations (Rutten, Van Joolingen, & Van der Veen, 2012), computer (microcomputer) assisted real and virtual laboratory (Balamuralithara & Woods, 2009), integrated learning systems (Wood, Underwood, & Avis, 1999), virtual learning environment (Piccoli, Ahmad, & Ives, 2001) and others.

The term overlaps with terms of computer-based instruction (Kulik & Kulik, 1991) and computer assisted instruction (Levin, Glass, & Meister, 1987). However, the term differs from other terms above by not mentioning the technology it utilizes in education, so generally it can be used also as a part of mobile learning (Motiwalla, 2007) and other instructional technologies, e.g. virtual reality (Byrne & Furness, 1994) or augmented reality (Wu, Lee, Chang, & Liang, 2013). ES is a computer program able to at least partially replace the teacher; it teaches pupils, it practices with them and it tests them. This type of software can be called "teacher (tutor)" figuratively from the classification of Taylor (1980) about the usage of computers in education. In the Czech translation the terms *didactical software* or *didactical program* are also used instead of *educational software*. The reason lies in the understanding and use of the word didactic in a sense of the "art of teaching" (Comenius, 1907) among Czech teachers. Historically the term (educational) program relates to early introduction of the use of the term *programmed learning* (Skinner, 2013).

### *Research Focus*

Previous researches dealing with acceptance, usage and implementation of technology in education mostly follow the theories which focus on acceptance technology in everyday life, i.e. Theory of Reasoned Action (TRA; Fishbein & Ajzen, 1975), Technology Acceptance Model (TAM; Davis, Bagozzi, & Warshaw, 1989), Theory of Planned Behaviour (TPB; Ajzen, 1991), Task Technology Fit (Goodhue & Thompson, 1995) or Unified Theory of Acceptance and Use of Technology (UTAUT; Venkatesh et al., 2003). Some researchers also consider other theories such as Diffusion of Innovations Theory (Rogers, 2003), Social Cognitive Theory (Bandura, 1986) and Motivational Model (Davis, Bagozzi, & Warshaw, 1992) in a sense of other factors affecting human behaviours. A review of researches showed that TAM is the most used theory in e-learning acceptance research (Šumak, Heričko, & Pušnik, 2011). This conclusion was confirmed by another research (Abdullah & Ward, 2016) focusing on the development of General Extended Technology Acceptance Model for E-Learning (GETAMEL). Same as Abdullah & Ward (2016) other research extended TAM model about additional factors that can affect users' behaviour towards the use of technologies in education (e.g. Arenas-Gaitán, Ramírez-Correa, & Rondán-Cataluña, 2011; Persico, Manca, & Pozzi, 2014), or researches using combinations of TAM model with other theories (e.g. Lee, 2010; Teo, 2011). Because of the lack of researches focused directly on educational software, the present research investigates also researches focusing on e-learning technology, whose acceptance and usage are influenced by the factors that should be close to the factors influencing similar educational technology, i.e. educational software.

1 Educational software and instructional software are interchangeable terms, same as educational technology and instructional technology are nowadays interchangeable (Januszewski & Molenda, 2008, p. 277).

Review articles (Abdullah & Ward, 2016; Šumak et al., 2011) focusing on e-learning also have shown that most of previous researches were concerned with students or learners' acceptance, attitude and use of e-learning technology or e-learning systems as end users of the technology. However, the most important factor of implementation of modern technology into education are teachers. Without teachers students would use educational technology only in in a few isolated cases based on their own interest. For these reasons, it is necessary to explore the factors, which influence implementation of education software from the perspective of teachers first (Lambic, 2014; Yuen & Ma, 2008).

The research focused on the usage of ICT by teachers in education generally. (Teo, 2011) confirms that Perceived Usefulness (PU), Attitude towards Use (ATU) and Facilitating Conditions (FC) have direct influences on Behavioral Intention to Use (BIU) technology, Perceived Ease of Use (PEU) and Subjective Norm (SN) influence BIU to use technology indirectly (PEU via ATU, SN via PU), so PU has stronger effect than SN. In other words, when teachers consider technology to be useful and more efficient in comparison with other means, or have a positive attitude to it, their intention to use such a technology will significantly increase. Also, the support of teachers by management and supportive environment have a greater effect on their intention to use technology in education than teachers' beliefs about opinions of important persons (Teo, 2011). The effect sizes of perceived ease of use and perceived usefulness of attitude towards the use of technology (precisely e-learning) were also found significant in meta-analyses of previous researches (Šumak et al., 2011), showing that ATU and PU has the greatest influence on BIU of e-learning in teachers' perspective.

It is understandable that teachers' tendency to use e-learning environments is encouraged by their perceptions of the added value of usage of technology (Mahdizadeh, Biemans, & Mulder, 2008) and this encouragement can be transferred to any other technology. However, the added value of new technology can depend on the way teachers use it in a classroom. According to Eng (2005), teachers implement ICT into education in three phases: the first phase depends on its manager and deals with the creation of amassing infrastructure; in the second phase technology is used by teachers in the same way they already perform teaching-learning processes, so there is not much added value of technology; in the last phase teachers change their teaching process according to possibilities of new technology and its innovative use.

Although it is obvious that ICT infrastructure is a prerequisite for its usage in teaching process; it is not a guarantor of frequency or efficiency of its usage in teaching process (Gil-Flores, Rodríguez-Santero, & Torres-Gordillo, 2017; Persico et al., 2014).

To fulfil the research aim the following research questions were set:

1. Are chosen constructs valid for evaluation of teachers' attitudes toward usage (USE) of educational software in chemistry teaching?
2. Are there differences between users and nonusers of educational software?
3. Are there differences between different types within a group of nonusers?

### *Theoretical Construct Affecting Acceptance and Usage of Educational Software*

#### Performance Expectancy

Performance Expectancy (PE) is a degree of persuasion that use of the system helps users to achieve improvement of job performance (Venkatesh et al., 2003). In this research, PE stands for the teacher's belief that the use of ES will contribute to their teaching performance (Šumak & Šorgo, 2016).

#### Effort Expectancy

Effort Expectancy (EE) is the degree of simplicity associated with the use of the system (Venkatesh et al., 2003). In this research, EE stands for the teacher's belief that the use of ES will be easy and understandable for them.

#### Social Influence

Social Influence (SI) is the degree of persuasion that important people for the users believe that he or she should use this new system (Venkatesh et al., 2003). In this research, SI stands for the teacher's important people according to their personal point of view (family, friends) or according to their work (colleagues, pupils, parents of pupils, management).

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Personal Innovativeness in IT

Personal Innovativeness in IT (PIIT) is the willingness of a person to try out any new information technology (Agarwal & Prasad, 1998). In this case, it stands for teachers, who will try out and implement new ICT in their lessons. This factor can be a strong predictor of BI to use an ES and the actual use of ICT applications in chemistry lessons.

Facilitating Conditions

Facilitating Conditions (FC) is the degree of persuasion of the user that there is an organizational and technical infrastructure to support the use of the system (Venkatesh et al., 2003). In this research, FC stands for the teacher's belief that their school has adequate facilities and conditions to use ES in chemistry teaching. According to the UTAUT model (Venkatesh et al., 2003) it is supposed that FC is a predictor of the actual use of ES in chemistry teaching.

Attitude towards Using

The Attitude towards Using (ATU) is an individual's overall affective reaction to the use of a system, which includes the feelings of favourableness or unfavourableness towards this behaviour (Ajzen, 1991). In this research, ATU comprises feelings towards using ES in chemistry teaching. It is considered that ATU is a predictor of behavioural intention to use and the actual use of ES in chemistry teaching. It can be influenced by motivation, which includes reasons why teachers use ES in chemistry teaching.

Perceived Pedagogical Impact

Perceived Pedagogical Impact (PPI) represents teacher's belief that the usage of ES in chemistry teaching will have impact on education in this research. This belief can affect ATU and USE.

Behavioural Intention

Behavioural Intention (BI) indicates how hard people are willing to try to perform the behaviour (Ajzen, 1991). It is a person's perceived likelihood or subjective probability of performance of behaviour. In this case, BI indicates a teacher's belief that they will use ES in chemistry teaching. BI is a strong predictor of the use according the UTAUT model (Venkatesh et al., 2003).

## Methodology of Research

In order to obtain answers to research questions about validity of constructs exploring factors affecting use of educational software online, survey was administered to the Czech chemistry teachers from elementary and secondary school in a timeframe four months from the end of November 2016 to the end of March 2017.

### *Sample of Research*

In the Czech Republic there are approximately 2,250 primary schools with the second stage and 1,300 grammar schools and secondary technical schools together according to the Register of Schools of the Ministry of Education, Youth and Sports (MŠMT, © 2017). Population of chemistry teachers of the Czech Republic is approximately between 6,000 to 6,500 people; assuming that there are on average 1.2 chemistry teachers per school at primary schools and on average 2.5 chemistry teachers per school at secondary schools. The sample size in the confidence level of 95% and error level of 5% is at least 363 persons for random sampling calculated using SRSC (CustomInsight, © 2017) and according to the rule of thumb for this type of exploratory research (Kline, 2011) sample, more than 200 participants is necessary. It was not possible to provide random sampling, so the purposive sample (Teddlie, 2007) was used. The questionnaire was addressed to the teachers from all available schools with the focus on schools, where chemistry is taught as a general-education subject (i.e. primary schools and grammar schools). Data collecting was ended when 550 responses were passed, which represents approximately about 8.5 % of the chemistry teacher population. Demographic characteristics of the sample are presented in Table 1.

**Table 1. Demographic characteristics of the sample.**

| Item | N | Frequency | % |
|---|---|---|---|
| *Your gender* | 556 | | |
| Male | | 92 | 16.8 |
| Female | | 457 | 83.2 |
| *Your age* | 555 | | |
| Less than 25 years | | 2 | 0.4 |
| 25 – 34 years | | 97 | 17.5 |
| 35 – 44 years | | 172 | 31.0 |
| 45 – 54 years | | 169 | 30.5 |
| More than 54 years | | 115 | 20.7 |
| *What is your university educational background?* | 556 | | |
| Education of chemistry for the lower secondary education | | 103 | 18.5 |
| Education of chemistry for the upper secondary education | | 136 | 24.5 |
| Education of chemistry for 5$^{th}$ to 12$^{th}$ year (lower and upper secondary education) | | 142 | 25.5 |
| Professional chemistry with pedagogical minimum | | 92 | 16.5 |
| Professional chemistry without pedagogical minimum | | 5 | 0.9 |
| Chemistry focused on education | | 9 | 1.6 |
| Other (please specify): | | 69 | 12.4 |
| *Your current status* | 556 | | |
| Teacher (with teaching qualifications) | | 532 | 95.7 |
| Teacher complementing teaching qualifications | | 15 | 2.7 |
| Other (please specify): | | 9 | 1.6 |
| *What is the length of your teaching practice?* | 556 | | |
| Less than 1 year | | 16 | 2.9 |
| 1– 5 years | | 62 | 11.2 |
| 6 – 25 years | | 329 | 59.2 |
| More than 25 years | | 149 | 26.8 |
| *Your primary work place* | 555 | | |
| The 2$^{nd}$ stage of primary school | | 365 | 65.8 |
| Grammar school | | 131 | 23.6 |
| Secondary technical school | | 55 | 9.9 |
| Other (please specify): | | 4 | 0.7 |
| *State what your second (or. another) teaching qualified subject is. (Open Question)* | | | |

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| Item | N | Frequency | % |
|---|---|---|---|
| *State what subjects you are teaching at you primary work place. (Open Question)* | | | |
| *Do you have opportunity make familiar with educational software? (Multiple Answer Questions)* | 556 | | |
| No | | 216 | 38.8 |
| Yes, during university education | | 55 | 9.9 |
| Yes, during additional education for teachers | | 139 | 25.0 |
| Yes, during self-study or self-interest | | 217 | 39.0 |
| Other (please specify): | | 14 | 2.5 |
| *Do you use educational software?* | 556 | | |
| Yes | | 183 | 32.9 |
| Have tried and abandoned | | 23 | 4.1 |
| No and I do not plan it | | 138 | 24.8 |
| No, but I plan to | | 212 | 38.1 |

*Instrument and Procedures*

Instrument development

The questionnaire was developed and administered through the open source application 1KA (https://www.1ka.si/). The questionnaire was branched by respondents' answers about their use of educational software: for users it contained 97 items, for non-users 79 items and for former users 104 items. These items were divided into three categories: 1) demographic statements about the teachers; 2) items used as measures for the theoretical constructs (see Appendix A and Appendix B); 3) additional question depending on the usage of educational software.

Demographic statements (1) contain items about teachers' gender, age, working status, length of teaching experience, primary work place, qualified and taught subjects, earlier experience with educational software, use of educational software in chemistry education, etc. (see Table 1). The theoretical constructs (2) were operationalized according to the items that were used for estimating technology acceptance (Agarwal & Prasad, 1998; Šumak & Šorgo, 2016; Šumak et al., 2017; Venkatesh et al., 2003) and adapted to the context of educational software. The items for constructs measuring were established as a 7-point Likert scale with choices between defined extreme from "strongly disagree" (1) to "strongly agree" (7). Seven-point scale was our choice in order to increase scale sensitivity following recommendation of Finstad (2010) "that 7-point Likert items provide a more accurate measure of a participant's true evaluation and are more appropriate for electronically-distributed and otherwise unsupervised usability questionnaires" (p. 104). According to Šumak & Šorgo (2016), some of the items were worded with negation (e.g. ATU1, FC3). The additional items (3) were also divided into three categories: a) for users' questions concerning the frequency of use, the inclusion of educational software in chemistry teaching; b) for non-users the reasons why they do not use educational software, c) for former users combination of a) and b).

Validation of the instruments

In the first phase, the questionnaire was translated from originally English statements to Czech language. The previous translation of the questionnaire adapting statements for measure acceptance and usage of interactive whiteboards (Šumak & Šorgo, 2016) was followed. To improve the translation, three experts in the field of chemistry education were asked to check the content of the questionnaire, its meaningfulness, clarity and relevance of its items. After that, the questionnaire was sent to 20 Czech teachers, who were asked to fill in the questionnaire, add comments and write down their perceptions and recommendations. Thanks to their feedback, the wording was refined. After that, data collection was started and reliability coefficient was checked after receiving of 100 complete responses. The result of the statistical analysis proves satisfying reliability for measurement items as well (Cronbach's α was .94 for model items), so the sampling continued.

Sampling process

The sampling was started by selection of primary and secondary schools in each region of the Czech Republic, which is divided in 13 regions and Prague. The list of schools was taken from the Register of Schools of the Ministry of Education, Youth and Sports (MŠMT, 2016). Schools without chemistry subject were excluded from the sample, e.g. primary schools only with the first stage, or special and vocational schools. In the selected schools where it was possible to identify names, affiliations and e-mails from school websites, all teachers qualified to teach chemistry were addressed directly. If it was not possible to obtain direct contacts, school directors or their deputies were asked to forward the link with the questionnaire to chemistry teachers. Altogether, the questionnaire was sent directly to 1,390 teachers of chemistry and to 1,116 directors or their deputies from 2,266 primary schools and to 1,159 teachers and 135 directors or their deputies from 423 secondary schools (mainly grammar schools). To sum up, 2,549 chemistry teachers directly and 1,294 schools indirectly were addressed; summative, an attempt to contact teachers from 2,689 schools was made. Each person was sent a polite e-mail asking them to fill up the questionnaire available online on the application 1KA. After 10 days from the first addressing, a reminder was sent to them. After four months of the data collection, the process ended. 1,792 teachers entered the introduction of online questionnaire, 1,348 of them started answering the questionnaire, and 564 completed responses and 459 partially completed responses were received. After analysing the completed questionnaires, 8 non-valid responses were excluded, so the final data analysis was performed on 556 completed questionnaires.

### *Data Analysis*

The data from 1Ka survey system were exported as an Excel file. After initial checking, the cleared data were transferred to IBM SPSS 24 statistical package. A data analysis was followed by standard statistical procedures for such a type of exploratory research (Field, 2009). Due to the non-normal distribution of some answers, nonparametric statistics was chosen.

Differences between users and nonusers

Among different personal characteristics and traits (Table 1), the only actual use of educational software was considered in the research. Other internal and external factors, such as gender, can influence decision to apply software or not, however, from the point of a student, what matters is the application of a software, regardless its obstacles or personal views of a teacher. While division of teachers into users (UT1) and nonusers (UT2, UT3, UT4) is obvious, differences within group of nonusers can be hidden and difficult to determine. Nonusers can be divided in at least three different subgroups, recognized on a basis of answers of respondents to the question: "*Do you use educational software?*" These groups are: a) former users, i.e. UT2 (the answer "*Have tried and abandoned*"); b) non-planning nonusers, i.e. UT3 (the answer "*No and I do not plan it*"); c) planning nonusers, i.e. UT4 (answer "*No, but I plan to*"). The effect size r was calculated according to recommendations in Field (2009). Interpretation of effect sizes is based on Cohen's guidelines (Cohen, 1988), where $r < .1$ stands for non-significant (ns), $.1 \le r < .3$ stands for small effect (S), $.3 \le r < .5$ stands for medium effect (M) and $r \ge .5$ stands for large effect (L).

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**Results of Research**

*Reliabilities of the Constructs*

**Table 2. Differences in scale reliabilities of constructs reported as Cronbach's alpha.**

| Code | Item | All users | UT1 | UT2 | UT3 | UT4 |
|---|---|---|---|---|---|---|
| *PE* | *Performance Expectancy* | | | | | |
| | (PE1, PE2, PE3) | .91 | .92 | .85 | .86 | .86 |
| *EE* | *Effort Expectancy* | | | | | |
| | (EE1, EE2, EE3(R)) | .87 | .84 | .91 | .85 | .87 |
| *FC* | *Facilitating Conditions* | | | | | |
| | (FC1, FC2, FC3) | .74 | .69 | .74 | .68 | .70 |
| *SI* | *Social Influence* | | | | | |
| | (SC1, SC2, SC3, SC4, SC5, SC6, SC7, SC8) | .89 | .88 | .73 | .86 | .86 |
| *ATU* | *Attitude towards Using* [a] | | | | | |
| | (ATU1 (R), ATU2, ATU3, ATU4, ATU5 (R), ATU6 (R)) | .82 | .78 | .75 | .65 | .73 |
| *BI* | *Behavioural Intention* | | | | | |
| | (BI1, BI2, BI3) | .98 | .95 | .95 | .95 | .94 |
| *USE* | *Use* | | | | | |
| | (USE1, USE2, USE3) | .89 | .81 | .64 | .87 | .79 |
| *PIIT* | *Personal Innovativeness in IT* | | | | | |
| | (PIIT1, PIIT2, PIIT3, PIIT4 (R)) | .89 | .88 | .93 | .84 | .88 |
| *M* | *Motivation* | | | | | |
| | (M1, M2, M3, M4, M5) | .88 | .81 | .87 | .84 | .84 |
| *PPI* | *Perceived Pedagogical Impact* | | | | | |
| | (PPI1, PPI2, PPI3, PPI4, PPI5, PPI6, PPI7, PPI8) | .93 | .89 | .90 | .94 | .92 |

*Note. a. ATU: with deletion of ATU5 (R), alphas raise to .88, .86, .79, .77 and .83 respectively.*

From the Cronbach's alphas presented in Table 2, can be concluded that all chosen constructs in the case of all users pass the threshold level of .7, so they can be applied in follow up or similar researches of this type. In the case of individual calculations for each user type, it was found, that in some cases alphas fall in a range between .6 and .7, however, by some authors this is still an acceptable alpha level in exploratory researches (Field, 2009). Cronbach's alpha of all chosen constructs together is .96, showing that all constructs combined or separated can be used in follow up researches. All constructs are unidimensional, based on PCA Analysis with Direct Oblimin rotation (data not shown).

*Frequency Distribution of the Answers Forming Constructs*

From the frequency distribution of the answers (see Appendix C) and particularly from modes, it was possible to recognize that chosen constructs have different power to facilitate extreme responses (strongly agree: modes 6 and 7 or strongly disagree: modes 1 and 2). However, in some other constructs results tend to accumulate around neutral values (modes 3, 4, 5). The biggest match is in ATU1 when 72.7 % of current users (UT1) answered that they strongly disagree (1) with the statement "*Using educational software is a bad idea in chemistry teaching*". It is unique because another big match has 61.2 % (BI2) and 60.1 % (BI3) in strongly agreement from current users (UT1) followed by 55.8 % and 55.1% in same items (BI2 and BI3) but differently from in this case it is strongly disagree (1) of non-planning nonusers (UT3). Other modes have lower than 50 % of responses. To sum up, responses of current users (UT1) are mostly in modes 6 and 7 (PE1, EE2, all items from FC, SI5, SI6, ATU2–ATU4, all items from BI, USE2, USE3, M1, M3, M4, PP1–PPI4), when mode of 1 and 2 appear at mostly former users (UT2) and non-planning nonusers (UT3) in items as SI1–SI3 for both groups, all items from BI for UT3, PP1–PPI3 for UT2 and so on. Differences between groups are exceeded in item ATU5 "*Educational software should be the only supplement of chemistry teaching,*" where all user types have mode 6 (UT2, UT3, UT4) or 5 (UT1), which can be explained by a realistic and rational view of teachers to the use of the EC in chemistry teaching.

*Statistical Differences in Constructs among Users and Nonusers*

**Table 4. Differences in constructs between users and type of nonusers**

| | Diff UT1 – UT2a | | Diff UT1 – UT3a | | Diff UT1 – UT4a | | Diff UT2 – UT3a | | Diff UT2 – UT4a | | Diff UT3 – UT4a | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Codes | r | Int | r | Int | r | Int | r | Int | r | Int | r | Int |
| PE1 | .20 | S | .59 | L | .20 | S | .27 | S | .08 | ns | .50 | M |
| PE2 | .35 | M | .56 | L | .19 | S | .00 | ns | .25 | S | .43 | M |
| PE3 | .35 | M | .56 | L | .18 | S | .01 | ns | .25 | S | .43 | M |
| EE1 | .14 | S | .33 | M | .07 | ns | .08 | ns | .08 | ns | .26 | S |
| EE2 | .13 | S | .40 | M | .13 | S | .15 | S | .04 | ns | .28 | S |
| EE3 (R) | .07 | ns | .29 | S | .15 | S | .12 | S | .02 | ns | .14 | S |
| FC1 | .16 | S | .48 | M | .30 | M | .13 | S | .00 | ns | .21 | S |
| FC2 | .18 | S | .43 | M | .23 | S | .11 | S | .05 | ns | .23 | S |
| FC3 | .07 | ns | .34 | M | .13 | S | .30 | M | .14 | S | .20 | S |
| SI1 | .28 | S | .47 | M | .22 | S | .01 | ns | .16 | S | .30 | S |
| SI2 | .35 | M | .51 | L | .25 | S | .02 | ns | .22 | S | .33 | M |
| SI3 | .27 | S | .46 | M | .16 | S | .04 | ns | .17 | S | .31 | M |
| SI4 | .17 | S | .33 | M | .09 | ns | .03 | ns | .12 | S | .26 | S |
| SI5 | .18 | S | .37 | M | .16 | S | .05 | ns | .08 | ns | .21 | S |
| SI6 | .21 | S | .41 | M | .22 | S | .06 | ns | .10 | ns | .24 | S |
| SI7 | .28 | S | .47 | M | .17 | S | .02 | ns | .18 | S | .34 | M |
| SI8 | .22 | S | .32 | M | .00 | ns | .02 | ns | .20 | S | .30 | M |
| ATU1 (R) | .26 | S | .59 | L | .27 | S | .14 | S | .13 | S | .42 | M |
| ATU2 | .20 | S | .59 | L | .16 | S | .20 | S | .10 | S | .47 | M |
| ATU3 | .27 | S | .56 | L | .11 | S | .13 | S | .19 | S | .47 | M |
| ATU4 | .31 | M | .63 | L | .21 | S | .09 | ns | .19 | S | .48 | M |
| ATU5 (R) | .19 | S | .20 | S | .20 | S | .07 | ns | .06 | ns | .01 | ns |
| ATU6 (R) | .25 | S | .58 | L | .24 | S | .10 | S | .13 | S | .42 | M |
| BI1 | .44 | M | .81 | L | .60 | L | .27 | S | .16 | S | .55 | L |
| BI2 | .45 | M | .83 | L | .67 | L | .31 | M | .09 | ns | .54 | L |
| BI3 | .46 | M | .83 | L | .67 | L | .27 | S | .13 | S | .54 | L |
| USE1 | .48 | M | .61 | L | .27 | S | .22 | S | .41 | M | .45 | M |
| USE2 | .48 | M | .66 | L | .28 | S | .12 | S | .41 | M | .53 | L |
| USE3 | .40 | M | .57 | L | .12 | S | .14 | S | .35 | M | .49 | M |
| PIIT1 | .11 | S | .39 | M | .11 | S | .09 | ns | .06 | ns | .29 | S |
| PIIT2 | .13 | S | .37 | M | .16 | S | .08 | ns | .04 | ns | .21 | S |
| PIIT3 | .17 | S | .41 | M | .13 | S | .07 | ns | .09 | ns | .27 | S |
| PIIT4 (R) | .15 | S | .37 | M | .24 | S | .09 | ns | .01 | ns | .15 | S |
| M1 | .27 | S | .54 | L | .13 | S | .07 | ns | .21 | S | .46 | M |
| M2 | .16 | S | .42 | M | .14 | S | .09 | ns | .10 | ns | .33 | M |

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| | Diff UT1 – UT2a | | Diff UT1 – UT3a | | Diff UT1 – UT4a | | Diff UT2 – UT3a | | Diff UT2 – UT4a | | Diff UT3 – UT4a | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| M3 | .23 | S | .47 | M | .13 | S | .04 | ns | .16 | S | .40 | M |
| M4 | .19 | S | .57 | L | .14 | S | .15 | S | .14 | S | .50 | L |
| M5 | .12 | S | .47 | M | .01 | ns | .18 | S | .11 | S | .50 | M |
| PPI1 | .12 | S | .46 | M | .20 | S | .17 | S | .01 | ns | .29 | S |
| PPI2 | .15 | S | .45 | M | .13 | S | .16 | S | .08 | ns | .37 | M |
| PPI3 | .23 | S | .39 | M | .13 | S | .03 | ns | .16 | S | .28 | S |
| PPI4 | .26 | S | .29 | S | .02 | ns | .07 | ns | .24 | S | .28 | S |
| PPI5 | .21 | S | .47 | M | .15 | S | .15 | S | .11 | S | .35 | M |
| PPI6 | .29 | S | .47 | M | .16 | S | .01 | ns | .20 | S | .33 | M |
| PPI7 | .12 | S | .37 | M | .01 | ns | .08 | ns | .11 | S | .38 | M |
| PPI8 | .14 | S | .37 | M | .03 | ns | .08 | ns | .13 | S | .36 | M |

*Note: a. $n_{1(UT1)} = 183$, $n_{2(UT2)} = 23$, $n_{3(UT3)} = 138$, $n_{(UT4)} = 212$, $N_{12} = 206$, $N_{13} = 321$, $N_{14} = 395$, $N_{23} = 161$, $N_{24} = 235$, $N_{34} = 350$; $r < .1$ stands for non-significant (ns), $.1 \le r < .3$ stands for small effect (S), $.3 \le r < .5$ stands for medium effect (M) and $r > .5$ stands for large effect (L)*

Based on values of effect sizes presented in Table 4, can be concluded that nonusers are not a homogenous group (for more detail see Appendix D). Generally, the greatest difference between types of nonusers is between nonusers, who do not plan use of ES (UT3) and nonusers, who plan it (UT4). Differences in those types fall in some cases even in a large rank, mostly in BI and statement that they have to feel they have to use ES. Cases with a medium rank appear in constructs such as PE, SI, ATU, USE, M and PPI. Difference between other types of nonusers, i.e. UT2 and UT3 and UT2 and UT4 is mostly small or none. With the exception of a medium rank in USE in comparison of UT2 and UT4, which is not a great surprise when UT2 abandoned usage of ES and UT4 and are planning to use it in future. In comparison of different types of nonusers with users the greatest difference was found between users and nonusers UT3, effect sizes fall in a large rank in constructs PE, ATU, BI, USE and M, in a medium rank in other constructs only with the exception of statements EE3 (R) and PPI4.

**Discussion**

The aim of this research was to empirically validate chosen constructs for evaluation of teachers' attitudes toward usage of educational software (ES) in chemistry education in the Czech Republic and to search for differences between types of users. The research was attended by a representative from all predictive groups: current users, former users, non-planning nonusers and planning nonusers. However, the group of former users has strongly fewer representatives than other groups, which could cause deviations in the results.

Results of descriptive analyses demonstrate that current users believe ES improves their teaching performance. Planning nonusers are also inclined to think that ES would help them improve their teaching, but not as strongly as users. While current users and non-planning nonusers disagree more or choose neutral attitude with the exception of the statement "*I find educational software useful in chemistry education*", the former users agree with it more. This exception indicates that they abandoned usage of ES for a different reason than its usefulness.

In the case of Effort Expectancy, all groups declare that they have not or would not have problem to work with ES, but for obvious reasons current and former users are surer with that while nonusers are closer to the neutral statement. Similarly, users and current users agree that they have sufficient equipment, knowledge and support, while the answers of other nonusers are close to the normal distribution. In combination with their Personal Innovativeness in IT, those results show, that each group has almost uniform representation from innovators to laggards (Rogers, 2003), but non-planning nonusers are slightly shifted towards the laggards.

Regarding the other people's expectation of teachers' usage of ES in any group feels pressure from their closer people, colleges or students´ parents. Generally, users and planning nonusers have more support from school management and school than former users and non-planning nonusers. Interesting is the result concerning the expectation of a student – current users and planning nonusers believe that their students expect from them the use of ES. In the case of planning nonusers, it can mean that one of their motives to use ES in future follows the conviction of student expectation. Results also show that non-planning nonusers have not intrinsic motivation to use ES; similar approach can be observed in the case of former users, while planning nonusers and users are more motivated. Based on this result is expected that intrinsic motivation will be an important factor to the acceptance of ES. This is confirmed by the results (Hrtoňová, Kohout, Rohlíková, & Zounek, 2015) when the intrinsic motivation is considered as the decisive factor for the acceptance of e-learning course by teachers.

Other interesting results are dealing with teachers' attitude towards ES; all groups have positive or neutral attitude with some differences: current users have strongest belief in the added value of ES usage in chemistry teaching, they most enjoy and like ES usage; planning nonusers have similar attitudes. Former users and non-planning nonusers are on a scale closer to the neutral part, but what is important is that they have not strongly negative attitudes toward ES. This fact implicates that teachers do not condemn the usage of ES because of the negative attitude, but from other reasons. More positive attitude than was expected can be caused by their awareness with possible advantages of the usage of ES in education. When comparing their beliefs in pedagogical impact of ES was found out that current users, former users and planning nonusers are rather convinced about pedagogical impact of ES on education than non-planning nonusers, whose distribution of answers is similar to kurtosis normal distribution, i.e. they have most answers in the neutral point of the scale.

The greatest differences between groups are in Behavioural Intention to use (BI) and use as such (USE) of ES, where each group has a different distribution of answers mostly in agreement with their classification in the group. However, taking into consideration that they were grouped on the basis of their statement, in a few cases deviations in these items of Behavioural Intention from their own identification can be found. This fact needs to be considered in further statistical processing, for example when building a behavioural model for each group of users or nonusers.

Analyses of the effect size show that the above described differences are between users and all non-users generally. Similar results can be observed in (Šumak & Šorgo, 2016) where the difference between pre-adopters and post-adopters in relation to acceptance and use of interactive whiteboards by teachers was proven. Results of this research also demonstrate differences between various types of nonusers. The first finer dividing of type of users was applied in (Šumak et. al., 2017) who deal with prospective, existing, and former users and establish different structural models for each user type. This research goes even further in the division of users into groups. Results confirm that between subgroups of nonusers are differences, so factors and their influence on the acceptance and the use of ES in chemistry teaching should be explored for each group separately. Based on the findings of the research, the following suggestion is to establish four structural models describing teachers' intention to use ES through the factors affecting their intention to use ES and ES using itself, one model for each type of the user. The development of four different models will make it possible to precisely target the factors, which affect teachers' acceptance and use of ES in chemistry education. Based on those models, ways to encourage teachers in usage of this technology in education could be determined.

This research has some limitations that should be taken into consideration. Although thanks to the distribution to all primary and grammar schools, all teachers have the opportunity to participate in the research; it cannot be guaranteed if the addressed directors or their deputies delivered the information about this research to the teachers. Similarly, in the case of direct addressing of the teacher, the participation of the research was based on their voluntary decision. This research was attended mostly by expert teachers with an appropriate qualification for this profession, so they should have the greatest insight into their field and the results can be extended to other experts. The next limitation is related to the fact that questionnaire was addressed only to Czech teachers. It was because of different teachers' experience and condition of education, related to cultural and geographic differences. The research can be repeated also in other countries in the European Union to expand the scope of this research.

## Conclusions

This research was focused on detection of differences between users and subgroups of non-users of educational software. From the results it can be revealed, that the individual constructs of our study do have the appropriate statistical properties, so they can be applied in search for answers about suitability of educational software for chemistry education, and potential pitfalls when trying to introduce it in regular practice. Results confirm that between subgroups of nonusers exist differences in constructs (namely Facilitating Conditions, Attitude towards Using, Behavioral Intention, Use, Motivation and Perceived Pedagogical Impact), which was expected. The unex-

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pected finding was that differences among different types of nonusers can be even larger than between users and nonusers. An especially outstanding group are those who do not use educational software and do not plan to use it in the future. In comparison with each other there can be observed several similarities in some cases: current users and planning nonusers both believe in the beneficial effect of usage of educational software in general, and former users are more like non-planning nonusers, but the results of former users are influenced by their previous experience working with educational software which non-planning nonusers do not have.

The results demonstrate the necessity of developing separate models addressing different levels of software usage among teachers. So, consequent factors and their influence on the acceptance and the use of educational software in chemistry education should be explored for each group separately if someone has intentions to successfully expand the use of educational software to sceptics.

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**References**

Abdullah, F., & Ward, R. (2016). Developing a general extended technology acceptance model for e-learning (GETAMEL) by analysing commonly used external factors. *Computers in Human Behaviour*, *56*, 238-256.

Agarwal, R., & Prasad, J. (1998). A conceptual and operational definition of personal innovativeness in the domain of information technology. *Information Systems Research*, *9* (2), 204-215.

Ajzen, I. (1991). The theory of planned behaviour. *Organizational Behaviour and Human Decision Processes*, *50* (2), 179-211.

Arenas-Gaitán, J., Ramírez-Correa, P. E., & Rondán-Cataluña, F. J. (2011). Cross - cultural analysis of the use and perceptions of web based learning systems. *Computers & Education*, *57* (2), 1762-1774.

Balamuralithara, B., & Woods, P. C. (2009). Virtual laboratories in engineering education: The simulation lab and remote lab. *Computer Applications in Engineering Education*, *17* (1), 108-118.

Bandura A. (1986). *Social foundations of thought and action: A Social Cognitive Theory*. Englewood Cliffs, NJ: Prentice-Hall.

Bingimlas, K. A. (2009). Barriers to the successful integration of ICT in teaching and learning environments: A review of the literature. *Eurasia Journal of Mathematics, Science & Technology Education*, *5* (3), 235-245.

Byrne, C., & Furness, T. A. (1994, January). Virtual reality and education. In Wright, June L., & Benzie, David (Eds.). *Exploring a new partnership: children, teachers, and technology: proceedings of the IFIP WG3.5 International Working Conference on Exploring a New Partnership, Children, Teachers, and Technology, Philadelphia, PA, U.S.A., 26 June-1 July 1994* (pp. 181-189). New York: Elsevier.

Chroustová, K., Bílek, M., & Šorgo, A. (2015). Development of the research tool to identify factors affecting the use of chemistry educational software. *Problems of Education in the 21st Century*, *68* (6), 6-21.

Cohen, J. (1988). *Statistical power analysis for the behavioural sciences* (Second edition). Hillsdale, N.J.: Lawrence Erlbaum Associates. Retrieved from https://books.google.cz/books.

Comenius, J. A. (1907). *The Great Didactic of John Amos Comenius* (Keatinge, M. V., Ed.). London: Adam and Charles Black.

CustomInsight (© 2017). Survey random sample calculator. *360 degree feedback, employee engagement surveys, employee satisfaction – CustomInsight*. Retrieved from http://www.custominsight.com/articles/random-sample-calculator.asp.

Davis, F. D., Bagozzi, R. P., & Warshaw, P. R. (1989). User acceptance of computer technology: A comparison of two theoretical models. *Management Science, 35* (8), 982-1003.

Davis, F. D., Bagozzi, R. P., & Warshaw, P. R. (1992). Extrinsic and intrinsic motivation to use computers in the workplace. *Journal of Applied Social Psychology*, *22* (14), 1111-1132.

Eng, T. S. (2005). The impact of ICT on learning: A review of research. *International Education Journal*, *6* (5), 635-650.

Finstad, K. (2010). Response interpolation and scale sensitivity: Evidence against 5-point scales. *Journal of Usability Studies*, *5* (3), 104-110.

Fishbein, M., & Ajzen, I. (1975). *Belief, attitude, intention and behaviour: An introduction to theory and research*. Reading, MA: Addison-Wesley Retrieved from http://people.umass.edu/aizen/f&a1975.html.

Funkhouser, C., & Richard Dennis, J. (1992). The effects of problem-solving software on problem-solving ability. *Journal of Research on Computing in Education*, *24* (3), 338-347.

Gil-Flores, J., Rodríguez-Santero, J., & Torres-Gordillo, J. J. (2017). Factors that explain the use of ICT in secondary-education classrooms: The role of teacher characteristics and school infrastructure. *Computers in Human Behavior*, *68*, 441-449.

Goodhue, D. L., & Thompson, R. L. (1995). Task-technology fit and individual performance. *MIS Quarterly*, *19* (2), 213-236.

Hennessy, S., Ruthven, K., & Brindley, S. (2005). Teacher perspectives on integrating ICT into subject teaching: commitment, constraints, caution, and change. *Journal of Curriculum Studies*, *37* (2), 155-192.

Hrtoňová, N., Kohout, J., Rohlíková, L., & Zounek, J. (2015). Factors influencing acceptance of e-learning by teachers in the Czech Republic. *Computers in Human Behavior*, *51*, 873-879.

Huang, W. D., Johnson, T. E., & Han, S. H. C. (2013). Impact of online instructional game features on college students' perceived motivational support and cognitive investment: A structural equation modeling study. *The Internet and Higher Education*, *17* (1), 58-68.

Januszewski, A., & Molenda, M. (Eds.). (2008). *Educational technology: A definition with commentary*. New York: Routledge.

Kara, Y., & Yeşilyurt, S. (2008). Comparing the impacts of tutorial and edutainment software programs on students' achievements, misconceptions, and attitudes towards biology. *Journal of Science Education and Technology*, *17* (1), 32-41.

Kline, R. B. (2011). Convergence of structural equation modelling and multilevel modelling. In M. Williams & W. P. Vogt (Eds.), *Handbook of methodological innovation in social research methods* (pp. 562-589). London: Sage.

Kostakis, V., Niaros, V., & Giotitsas, C. (2015). Open source 3D printing as a means of learning: An educational experiment in two high schools in Greece. *Telematics and Informatics*, *32* (1), 118-128.

Kubiatko, M., Balatova, K., Fancovicova, J., & Prokop, P. (2017). Pupils' Attitudes toward Chemistry in Two Types of Czech Schools. *EURASIA Journal of Mathematics Science and Technology Education*, *13* (6), 2539-2552.

Kuiper, E., & de Pater-Sneep, M. (2014). Student perceptions of drill-and-practice mathematics software in primary education. *Mathematics Education Research Journal*, *26* (2), 215-236.

Kulik, C. L. C., & Kulik, J. A. (1991). Effectiveness of computer-based instruction: An updated analysis. *Computers in Human Behavior*, *7* (1), 75-94.

Lambic, D. (2014). Factors influencing future teachers' adoption of educational software use in classroom. *Croatian Journal of Education*, *16* (3), 815-846.

Lee, M. C. (2010). Explaining and predicting users' continuance intention toward e-learning: An extension of the expectation–confirmation model. *Computers & Education*, *54* (2), 506-516.

Levin, H. M., Glass, G. V., & Meister, G. R. (1987). Cost-effectiveness of computer-assisted instruction. *Evaluation Review*, *11* (1), 50-72.

Mahdizadeh, H., Biemans, H., & Mulder, M. (2008). Determining factors of the use of e-learning environments by university teachers. *Computers & Education*, *51* (1), 142-154.

Martin, F., & Ertzberger, J. (2013). Here and now mobile learning: An experimental study on the use of mobile technology. *Computers & Education*, *68*, 76-85.

Merchant, Z., Goetz, E. T., Cifuentes, L., Keeney-Kennicutt, W., & Davis, T. J. (2014). Effectiveness of virtual reality-based instruction on students' learning outcomes in K-12 and higher education: A meta-analysis. *Computers & Education*, *70*, 29-40.

Milner-Bolotin, M. (2012). Increasing interactivity and authenticity of chemistry instruction through data acquisition systems and other technologies. *Journal of Chemical Education*, *89* (4), 477-481.

Mishra, P., & Koehler, M. J. (2006). Technological pedagogical content knowledge: A framework for teacher knowledge. *Teachers College Record*, *108* (6), 1017.

Moreno-Ger, P., Burgos, D., Martínez-Ortiz, I., Sierra, J. L., & Fernández-Manjón, B. (2008). Educational game design for online education. *Computers in Human Behaviour*, *24* (6), 2530-2540.

Motiwalla, L. F. (2007). Mobile learning: A framework and evaluation. *Computers & Education*, *49* (3), 581-596.

MŠMT (© 2017). Statistická ročenka školství [Statistical Yearbook of Education]. *Ministry of Education, Youth and Sports*. Retrieved from http://toiler.uiv.cz/rocenka/rocenka.asp.

Niederhauser, D. S., & Stoddart, T. (2001). Teachers' instructional perspectives and use of educational software. *Teaching and Teacher Education*, *17*(1), 15-31.

Oliver, R. (2002). The role of ICT in higher education for the 21st century: ICT as a change agent for education. In *Proceedings of the Higher Education for the 21st Century Conference, Curtin*. Miri, Australia: Curtin University.

Pelgrum, W. J. (2001). Obstacles to the integration of ICT in education: Results from a worldwide educational assessment. *Computers & Education*, *37* (2), 163-178.

Persico, D., Manca, S., & Pozzi, F. (2014). Adapting the technology acceptance model to evaluate the innovative potential of e-learning systems. *Computers in Human Behaviour*, *30*, 614-622.

Piccoli, G., Ahmad, R., & Ives, B. (2001). Web-based virtual learning environments: A research framework and a preliminary assessment of effectiveness in basic IT skills training. *MIS Quarterly*, *25* (4), 401-426.

Prestridge, S. (2012). The beliefs behind the teacher that influences their ICT practices. *Computers & Education*, *58* (1), 449-458.

Rau, P. L. P., Gao, Q., & Wu, L. M. (2008). Using mobile communication technology in high school education: Motivation, pressure, and learning performance. *Computers & Education*, *50* (1), 1-22.

Rogers, E. M. (2003). *Diffusion of innovations*. Fifth Edition. New York: The Free Press.

Rutten, N., Van Joolingen, W. R., & Van der Veen, J. T. (2012). The learning effects of computer simulations in science education. *Computers & Education*, *58* (1), 136-153.

Skinner, B. F. (2013). The technology of teaching. In Vargas, Julie S. (Ed.) *The technology of teaching*. BF Skinner Foundation. Reprint Series. Retrieved from https://books.google.cz/books (Original work published 1968).

Slabin, U. (2013). Teaching general chemistry with instructor's screen sharing: Students' opinions about the idea and its implementation. *Journal of Baltic Science Education*, *12* (6), 759-773.

Slay, H., Siebörger, I., & Hodgkinson-Williams, C. (2008). Interactive whiteboards: Real beauty or just "lipstick"? *Computers & Education*, *51* (3), 1321-1341.

Smith, H. J., Higgins, S., Wall, K., & Miller, J. (2005). Interactive whiteboards: boon or bandwagon? A critical review of the literature. *Journal of Computer Assisted Learning*, *21* (2), 91-101.

ISSN 1648–3898 /Print/
ISSN 2538–7138 /Online/

Šumak, B., & Šorgo, A. (2016). The acceptance and use of interactive whiteboards among teachers: Differences in UTAUT determinants between pre-and post-adopters. *Computers in Human Behaviour*, *64*, 602-620.

Šumak, B., Heričko, M., & Pušnik, M. (2011). A meta-analysis of e-learning technology acceptance: The role of user types and e-learning technology types. *Computers in Human Behaviour*, *27* (6), 2067-2077.

Šumak, B., Pušnik, M., Heričko, M., & Šorgo, A. (2017). Differences between prospective, existing, and former users of interactive whiteboards on external factors affecting their adoption, usage and abandonment. *Computers in Human Behaviour*, *72*, 733-756.

Taylor, R. (Ed.). (1980). *The computer in the school: Tutor, tool, tutee* (pp. 1-10). New York: Teachers College Press.

Teddlie, C., & Yu, F. (2007). Mixed methods sampling: A typology with examples. *Journal of Mixed Methods Research*, *1* (1), 77-100.

Teo, T. (2011). Factors influencing teachers' intention to use technology: Model development and test. *Computers & Education*, *57* (4), 2432-2440.

Türel, Y. K., & Johnson, T. E. (2012). Teachers' belief and use of interactive whiteboards for teaching and learning. *Educational Technology & Society*, *15* (1), 381-394.

Venkatesh, V., Morris, M. G., Davis, G. B., & Davis, F. D. (2003). User acceptance of information technology: Toward a unified view. *MIS Quarterly*, *27* (3), 425-478.

Viau, R., & Larivée, J. (1993). Learning tools with hypertext: An experiment. *Computers & Education*, *20* (1), 11-16.

Wang, Q. (2008). A generic model for guiding the integration of ICT into teaching and learning. *Innovations in Education and Teaching International*, *45* (4), 411-419.

Wood, D., Underwood, J., & Avis, P. (1999). Integrated learning systems in the classroom. *Computers & Education*, *33* (2), 91-108.

Wu, H. K., Lee, S. W. Y., Chang, H. Y., & Liang, J. C. (2013). Current status, opportunities and challenges of augmented reality in education. *Computers & Education*, *62*, 41-49.

Yucel, A. S., & Cevik, E. (2010). Teachers' Opinions on Computer-assisted Chemistry Teaching. *Electronic Journal of Social Sciences*, *9* (31), 88-102.

Yuen, A. H., & Ma, W. W. (2008). Exploring teacher acceptance of e-learning technology. *Asia-Pacific Journal of Teacher Education*, *36* (3), 229-243.

Záhorec, J., Hašková, A., & Bílek, M. (2014). Impact of Multimedia Assisted Teaching on Student Attitudes to Science Subjects. *Journal of Baltic Science Education*, *13* (3), 361-380.

**Appendix A. Measurement items and scales for current users (UT1) and former users (UT2)**

| Item | Statement |
|---|---|
| ***PE*** | ***Performance Expectancy*** |
| **PE1** | I find educational software useful in chemistry teaching. |
| **PE2** | Using educational software enables me to accomplish tasks related to chemistry teaching more quickly. |
| **PE3** | Using educational software increases the effect of my teaching. |
| ***EE*** | ***Effort Expectancy*** |
| **EE1** | It is easy for me to become skilful at using educational software. |
| **EE2** | I find educational software easy to use. |
| **EE3**[a] | Learning to operate educational software is difficult for me. |
| ***FC*** | ***Facilitating Conditions*** |
| **FC1** | I have the resources necessary to use educational software. |
| **FC2** | I have the knowledge necessary to use educational software. |
| **FC3** | A specific person (or group) is available for assistance with educational software difficulties. |
| ***SI*** | ***Social Influence*** |
| **SI1** | People who influence my behaviour think that I should use educational software in chemistry teaching. |
| **SI2** | People who are important to me think that I should use educational software in chemistry teaching. |
| **SI3** | Other teachers of chemistry think that I should use educational software in chemistry teaching. |
| **SI4** | General public think that I should use educational software in chemistry teaching. |
| **SI5** | The senior management of the school has been helpful in the use of educational software in chemistry teaching. |
| **SI6** | In general, the school climate is supportive towards the use of educational software. |
| **SI7** | Students expect me to use educational software in chemistry teaching. |
| **SI8** | Students' parents expect me to use educational software in chemistry teaching. |
| ***ATU*** | ***Attitude towards Using*** |
| **ATU1**[a] | Using educational software is a bad idea in chemistry teaching. |
| **ATU2** | Educational software makes chemistry teaching more interesting. |
| **ATU3** | Chemistry teaching with educational software is fun. |
| **ATU4** | I like chemistry teaching using educational software. |

| Item | Statement |
|---|---|
| **ATU5**[a] | Educational software should by only supplement of chemistry teaching. |
| **ATU6**[a] | Using educational software has no added value. |
| ***BI*** | ***Behavioural Intention*** |
| **BI1** | I intend to use educational software in chemistry teaching in the next 12 months. |
| **BI2** | I predict that I will use educational software in chemistry teaching in the next 12 months. |
| **BI3** | I plan to use educational software in chemistry teaching in the next 12 months. |
| ***USE*** | ***Use*** |
| **USE1** | I use educational software frequently. |
| **USE2** | I use educational software in chemistry teaching. |
| **USE3** | If available, I use educational software in chemistry teaching. |
| ***PIIT*** | ***Personal Innovativeness in IT*** |
| **PIIT1** | If I heard about a new information technology, I would look for ways to experiment with it. |
| **PIIT2** | Among my peers, I am usually the first to try out new information technology. |
| **PIIT3** | I like to experiment with new information technology. |
| **PIIT4**[a] | In general, I am hesitant to try out new information technology |
| ***M*** | ***Motivation*** |
| | *I use educational software in chemistry teaching because…* |
| **M1** | I believe that this is an interesting activity. |
| **M2** | of personal reasons. |
| **M3** | I feel good when I do it. |
| **M4** | I believe that this activity is important for me. |
| **M5** | I feel that I must do it. |
| ***PPI*** | ***Perceived Pedagogical Impact*** |
| | *Educational software use in teaching has an impact on …* |
| **PPI1** | the education process. |
| **PPI2** | students' curiosity. |
| **PPI3** | students' concentration. |
| **PPI4** | students' creativity. |
| **PPI5** | students' motivation. |
| **PPI6** | students' achievement. |
| **PPI7** | students' higher order thinking skills (critical thinking, analysis, problem solving). |
| **PPI8** | student's competence in transversal skills (learning to learn, social competences, etc.). |

*Note. a. Statement were worded with negation.*

**Appendix B. Measurement items and scales for non-planning nonusers (UT3) and planning nonusers (UT4)**

| Item | Statement |
|---|---|
| ***PE*** | ***Performance Expectancy*** |
| **PE1** | I find educational software useful in chemistry teaching. |
| **PE2** | Using educational software would enable me to accomplish tasks related to chemistry teaching more quickly. |
| **PE3** | Using educational software would increase the effect of my teaching. |
| ***EE*** | ***Effort Expectancy*** |
| **EE1** | It would be easy for me to become skilful at using educational software. |
| **EE2** | I find educational software easy to use. |
| **EE3**[a] | Learning to operate educational software would be difficult for me. |
| ***FC*** | ***Facilitating Conditions*** |
| **FC1** | I would have the resources necessary to use educational software. |
| **FC2** | I would have the knowledge necessary to use educational software. |
| **FC3** | A specific person (or group) would be available for assistance with educational software difficulties. |
| ***SI*** | ***Social Influence*** |
| **SI1** | People who influence my behaviour think that I should use educational software in chemistry teaching. |
| **SI2** | People who are important to me think that I should use educational software in chemistry teaching. |

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| Item | Statement |
|---|---|
| **SI3** | Other teachers of chemistry think that I should use educational software in chemistry teaching. |
| **SI4** | General public think that I should use educational software in chemistry teaching. |
| **SI5** | The senior management of the school would be helpful in the use of educational software in chemistry teaching. |
| **SI6** | In general, the school climate would be supportive towards the use of educational software**.** |
| **SI7** | Students would expect me to use educational software in chemistry teaching. |
| **SI8** | Students' parents would expect me to use educational software in chemistry teaching. |

| | |
|---|---|
| ***ATU*** | ***Attitude towards Using*** |
| **ATU1**[a] | Using educational software would be a bad idea in chemistry teaching. |
| **ATU2** | Educational software would make chemistry teaching more interesting. |
| **ATU3** | Chemistry teaching with educational software would be fun. |
| **ATU4** | I would like chemistry teaching using educational software. |
| **ATU5**[a] | Educational software should by only supplement of chemistry teaching. |
| **ATU6**[a] | Using educational software would have no added value. |
| ***BI*** | ***Behavioural Intention*** |
| **BI1** | I intend to use educational software in chemistry teaching in the next 12 months. |
| **BI2** | I predict that I will use educational software in chemistry teaching in the next 12 months. |
| **BI3** | I plan to use educational software in chemistry teaching in the next 12 months. |
| ***USE*** | ***Use*** |
| **USE1** | I would use educational software frequently. |
| **USE2** | I would use educational software in chemistry teaching. |
| **USE3** | If available, I would use educational software in chemistry teaching. |
| ***PIIT*** | ***Personal Innovativeness in IT*** |
| **PIIT1** | If I heard about a new information technology, I would look for ways to experiment with it. |
| **PIIT2** | Among my peers, I am usually the first to try out new information technology. |
| **PIIT3** | I like to experiment with new information technology. |
| **PIIT4**[a] | In general, I am hesitant to try out new information technology |
| ***M*** | ***Motivation*** |
| | *I would use educational software in chemistry teaching because…* |
| **M1** | I believe that this is an interesting activity. |
| **M2** | of personal reasons. |
| **M3** | I would feel good when I do it. |
| **M4** | I believe that this activity is important for me. |
| **M5** | I feel that I must do it. |
| ***PPI*** | ***Perceived Pedagogical Impact*** |
| | *Educational software use in teaching would have an impact on …* |
| **PPI1** | the education process. |
| **PPI2** | students' curiosity. |
| **PPI3** | students' concentration. |
| **PPI4** | students' creativity. |
| **PPI5** | students' motivation. |
| **PPI6** | students' achievement. |
| **PPI7** | students' higher order thinking skills (critical thinking, analysis, problem solving). |
| **PPI8** | student's competence in transversal skills (learning to learn, social competences, etc.). |

*Note. a. Statement were worded with negation.*

**Appendix C. Differences in descriptive statistics for indicators of theoretical constructs as predictors of actual use of educational software among Czech chemistry teachers on a Scale between F1 – strongly disagree, and F7 – strongly agree. (N(UT1) = 183; N(UT2) = 23; N(UT3) = 138; N(UT4) = 212)**

| Code | User type | F1 | F2 | F3 | F4 | F5 | F6 | F7 | M | SD | Med | Mode |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *PE* | *Performance Expectancy* | | | | | | | | | | | |
| **PE1** | **UT1** | 1.6 | 0.5 | 3.3 | 12 | 22.4 | 24.6 | 35.5 | 5.69 | 1.32 | 6 | 7 |
| | **UT2** | 0 | 4.3 | 13 | 13 | 39.1 | 21.7 | 8.7 | 4.87 | 1.29 | 5 | 5 |
| | **UT3** | 4.3 | 13.8 | 14.5 | 44.2 | 14.5 | 5.1 | 3.6 | 3.80 | 1.32 | 4 | 4 |
| | **UT4** | 0.9 | 0.5 | 3.8 | 22.2 | 26.9 | 32.1 | 13.7 | 5.25 | 1.18 | 5 | 6 |
| **PE2** | **UT1** | 1.6 | 3.3 | 6 | 18 | 30.6 | 22.4 | 18 | 5.12 | 1.39 | 5 | 5 |
| | **UT2** | 4.3 | 39.1 | 8.7 | 26.1 | 17.4 | 4.3 | 0 | 3.42 | 1.39 | 3 | 2 |
| | **UT3** | 11.6 | 22.5 | 12.3 | 38.4 | 12.3 | 2.2 | 0.7 | 3.27 | 1.35 | 4 | 4 |
| | **UT4** | 1.4 | 7.1 | 7.5 | 31.1 | 25.9 | 19.8 | 7.1 | 4.61 | 1.35 | 5 | 4 |
| **PE3** | **UT1** | 1.6 | 2.7 | 5.5 | 15.8 | 27.9 | 27.3 | 19.1 | 5.12 | 1.37 | 5 | 5 |
| | **UT2** | 8.7 | 17.4 | 17.4 | 34.8 | 17.4 | 4.3 | 0 | 3.76 | 1.34 | 4 | 4 |
| | **UT3** | 8.7 | 19.6 | 14.5 | 39.1 | 13 | 4.3 | 0.7 | 3.44 | 1.34 | 4 | 4 |
| | **UT4** | 0.5 | 5.2 | 9.4 | 26.4 | 26.9 | 23.6 | 8 | 4.77 | 1.30 | 5 | 5 |
| *EE* | *Effort Expectancy* | | | | | | | | | | | |
| **EE1** | **UT1** | 1.1 | 1.1 | 3.3 | 10.9 | 30.1 | 28.4 | 25.1 | 5.12 | 1.24 | 6 | 5 |
| | **UT2** | 8.7 | 0 | 4.3 | 30.4 | 17.4 | 21.7 | 17.4 | 4.83 | 1.70 | 5 | 4 |
| | **UT3** | 7.2 | 8 | 10.1 | 26.8 | 14.5 | 23.9 | 9.4 | 4.43 | 1.69 | 4 | 4 |
| | **UT4** | 0 | 2.4 | 6.6 | 21.7 | 16.5 | 29.7 | 23.1 | 4.40 | 1.35 | 6 | 6 |
| **EE2** | **UT1** | 0.5 | 2.2 | 2.7 | 13.7 | 25.1 | 36.1 | 19.7 | 5.48 | 1.21 | 6 | 6 |
| | **UT2** | 4.3 | 4.3 | 4.3 | 26.1 | 26.1 | 17.4 | 17.4 | 4.87 | 1.58 | 5 | 4[a] |
| | **UT3** | 6.5 | 6.5 | 12.3 | 39.9 | 12.3 | 11.6 | 10.9 | 2.89 | 1.58 | 4 | 4 |
| | **UT4** | 0.5 | 5.2 | 4.2 | 25.9 | 15.6 | 34.4 | 14.2 | 5.11 | 1.37 | 5 | 6 |
| **EE3** | **UT1** | 42.6 | 35.5 | 9.8 | 6 | 3.3 | 1.6 | 1.1 | 2.01 | 1.27 | 2 | 1 |
| | **UT2** | 34.8 | 34.8 | 0 | 26.1 | 0 | 0 | 4.3 | 2.39 | 1.56 | 2 | 1[a] |
| | **UT3** | 21.7 | 29 | 12.3 | 23.9 | 4.3 | 5.8 | 2.9 | 2.89 | 1.6 | 2 | 2 |
| | **UT4** | 31.1 | 34 | 10.4 | 14.6 | 3.8 | 5.7 | 0.5 | 2.45 | 1.47 | 2 | 2 |
| *FC* | *Facilitating Conditions* | | | | | | | | | | | |
| **FC1** | **UT1** | 0 | 2.7 | 5.5 | 13.1 | 19.7 | 30.1 | 29 | 4.62 | 1.32 | 6 | 6 |
| | **UT2** | 4.3 | 8.7 | 17.4 | 30.4 | 4.3 | 4.3 | 30.4 | 4.57 | 1.93 | 4 | 4[a] |
| | **UT3** | 12.3 | 14.5 | 13.8 | 30.4 | 8.7 | 12.3 | 8 | 3.78 | 1.76 | 4 | 4 |
| | **UT4** | 3.3 | 9.9 | 11.3 | 25.9 | 16.5 | 18.4 | 14.6 | 4.56 | 1.65 | 4 | 4 |
| **FC2** | **UT1** | 0 | 2.2 | 4.9 | 12 | 19.7 | 33.9 | 27.3 | 4.65 | 1.26 | 6 | 6 |
| | **UT2** | 0 | 4.3 | 21.7 | 30.4 | 8.7 | 13 | 21.7 | 4.70 | 1.61 | 4 | 4 |
| | **UT3** | 5.8 | 13.8 | 14.5 | 31.2 | 10.9 | 13 | 10.9 | 4.10 | 1.68 | 4 | 4 |
| | **UT4** | 2.4 | 6.1 | 9 | 22.6 | 20.8 | 21.2 | 17.9 | 4.89 | 1.56 | 5 | 4 |
| **FC3** | **UT1** | 3.3 | 7.1 | 8.7 | 12 | 13.1 | 26.2 | 29.5 | 5.21 | 1.75 | 6 | 7 |
| | **UT2** | 0 | 0 | 8.7 | 26.1 | 4.3 | 17.4 | 43.5 | 5.61 | 1.50 | 6 | 7 |
| | **UT3** | 10.1 | 13 | 12.3 | 29.7 | 13 | 13 | 8.7 | 3.96 | 1.74 | 4 | 4 |
| | **UT4** | 3.8 | 14.2 | 8 | 18.9 | 13.2 | 19.3 | 22.6 | 4.72 | 1.85 | 5 | 7 |
| *SI* | *Social Influence* | | | | | | | | | | | |
| **SI1** | **UT1** | 6 | 9.8 | 8.7 | 34.4 | 14.2 | 17.5 | 9.3 | 4.31 | 1.62 | 4 | 4 |
| | **UT2** | 34.8 | 17.4 | 8.7 | 30.4 | 0 | 8.7 | 0 | 2.70 | 1.64 | 2 | 1 |
| | **UT3** | 34.1 | 19.6 | 8.7 | 32.6 | 2.2 | 1.4 | 1.4 | 2.59 | 1.48 | 2 | 1 |
| | **UT4** | 14.2 | 10.8 | 10.4 | 45.8 | 9.9 | 7.1 | 1.9 | 3.55 | 1.47 | 4 | 4 |
| **SI2** | **UT1** | 4.9 | 7.7 | 11.5 | 32.2 | 15.8 | 20.2 | 7.7 | 4.38 | 1.55 | 4 | 4 |
| | **UT2** | 39.1 | 17.4 | 17.4 | 17.4 | 8.7 | 0 | 0 | 2.39 | 1.41 | 2 | 1 |
| | **UT3** | 37.7 | 17.4 | 9.4 | 30.4 | 3.6 | 0.7 | 0.7 | 2.50 | 1.44 | 2 | 1 |
| | **UT4** | 12.7 | 9.9 | 13.7 | 45.3 | 9.9 | 6.1 | 2.4 | 3.58 | 1.44 | 4 | 4 |
| **SI3** | **UT1** | 7.7 | 10.4 | 14.8 | 37.2 | 13.7 | 11.5 | 4.9 | 3.93 | 1.52 | 4 | 4 |

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| Code | User type | F1 | F2 | F3 | F4 | F5 | F6 | F7 | M | SD | Med | Mode |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **UT2** | 30.4 | 21.7 | 21.7 | 17.4 | 8.7 | 0 | 0 | 2.52 | 1.34 | 2 | 1 |
| | **UT3** | 37.7 | 20.3 | 10.9 | 29.7 | 0.7 | 0 | 0.7 | 2.38 | 1.34 | 2 | 1 |
| | **UT4** | 17.9 | 11.3 | 9.9 | 45.8 | 9.4 | 4.7 | 0.9 | 3.35 | 1.46 | 4 | 4 |
| **SI4** | **UT1** | 8.7 | 8.7 | 13.7 | 37.2 | 12.6 | 15.3 | 3.8 | 3.97 | 1.54 | 4 | 4 |
| | **UT2** | 30.4 | 17.4 | 4.3 | 30.4 | 8.7 | 4.3 | 4.3 | 3.00 | 1.81 | 3 | 1[a] |
| | **UT3** | 29 | 15.2 | 10.9 | 37.7 | 3.6 | 2.2 | 1.4 | 2.84 | 1.50 | 3 | 4 |
| | **UT4** | 11.3 | 10.8 | 11.3 | 45.3 | 10.8 | 7.1 | 3.3 | 3.68 | 1.47 | 4 | 4 |
| **SI5** | **UT1** | 0.5 | 2.2 | 3.8 | 14.8 | 20.2 | 33.9 | 24.6 | 5.52 | 1.28 | 6 | 6 |
| | **UT2** | 8.7 | 4.3 | 8.7 | 30.4 | 17.4 | 13 | 17.4 | 4.52 | 1.78 | 4 | 4 |
| | **UT3** | 8.7 | 10.1 | 7.2 | 30.4 | 16.7 | 16.7 | 10.1 | 4.27 | 1.72 | 4 | 4 |
| | **UT4** | 2.4 | 6.1 | 7.1 | 22.6 | 12.7 | 33.5 | 15.6 | 5.00 | 1.55 | 5 | 6 |
| **SI6** | **UT1** | 0.5 | 2.2 | 3.3 | 18 | 14.8 | 34.4 | 26.8 | 5.55 | 1.31 | 6 | 6 |
| | **UT2** | 4.3 | 13 | 4.3 | 30.4 | 21.7 | 13 | 13 | 4.43 | 1.67 | 4 | 4 |
| | **UT3** | 8 | 5.1 | 13 | 36.2 | 15.2 | 14.5 | 8 | 4.21 | 1.57 | 4 | 4 |
| | **UT4** | 1.4 | 3.8 | 9 | 20.8 | 25 | 28.3 | 11.8 | 4.96 | 1.38 | 5 | 6 |
| **SI7** | **UT1** | 1.6 | 2.2 | 6.6 | 25.7 | 24.6 | 23.5 | 15.8 | 5.03 | 1.36 | 5 | 4 |
| | **UT2** | 8.7 | 17.4 | 17.4 | 34.8 | 4.3 | 17.4 | 0 | 3.61 | 1.53 | 4 | 4 |
| | **UT3** | 18.1 | 10.1 | 10.1 | 46.4 | 5.1 | 6.5 | 3.6 | 3.44 | 1.58 | 4 | 4 |
| | **UT4** | 2.8 | 4.7 | 8.5 | 37.3 | 19.3 | 20.8 | 6.6 | 4.54 | 1.36 | 4 | 4 |
| **SI8** | **UT1** | 3.8 | 4.9 | 11.5 | 47 | 15.8 | 12.6 | 4.4 | 4.21 | 1.29 | 4 | 4 |
| | **UT2** | 13 | 26.1 | 8.7 | 43.5 | 0 | 8.7 | 0 | 3.17 | 1.44 | 4 | 4 |
| | **UT3** | 18.1 | 12.3 | 12.3 | 47.8 | 5.8 | 2.9 | 0.7 | 3.22 | 1.38 | 4 | 4 |
| | **UT4** | 3.8 | 9 | 9.9 | 42.5 | 17 | 14.2 | 3.8 | 4.17 | 1.36 | 4 | 4 |
| ***ATU*** | ***Attitude towards Using*** | | | | | | | | | | | |
| **ATU1** | **UT1** | 72.7 | 18 | 1.1 | 2.2 | 4.4 | 1.1 | 0.5 | 1.53 | 1.15 | 1 | 1 |
| | **UT2** | 30.4 | 17.4 | 13 | 30.4 | 4.3 | 0 | 4.3 | 2.78 | 1.62 | 3 | 4[a] |
| | **UT3** | 12.3 | 18.1 | 15.9 | 37 | 9.4 | 4.3 | 2.9 | 3.38 | 1.47 | 4 | 4 |
| | **UT4** | 42.5 | 28.3 | 12.7 | 13.2 | 0.5 | 2.8 | 0 | 2.09 | 1.26 | 2 | 1 |
| **ATU2** | **UT1** | 0 | 0.5 | 1.1 | 8.2 | 15.3 | 33.3 | 41.5 | 5.05 | 1.04 | 6 | 7 |
| | **UT2** | 0 | 8.7 | 4.3 | 17.4 | 26.1 | 21.7 | 21.7 | 5.13 | 1.52 | 5 | 5 |
| | **UT3** | 4.3 | 5.1 | 12.3 | 32.6 | 29.7 | 11.6 | 4.3 | 4.30 | 1.34 | 4 | 4 |
| | **UT4** | 0.5 | 1.4 | 0.9 | 13.2 | 25.5 | 29.7 | 28.8 | 5.66 | 1.18 | 6 | 6 |
| **ATU3** | **UT1** | 0 | 1.6 | 2.7 | 9.3 | 27.9 | 32.8 | 25.7 | 4.68 | 1.14 | 6 | 6 |
| | **UT2** | 0 | 8.7 | 4.3 | 34.8 | 34.8 | 8.7 | 8.7 | 4.57 | 1.27 | 5 | 4[a] |
| | **UT3** | 7.2 | 3.6 | 11.6 | 42 | 26.1 | 8 | 1.4 | 4.06 | 1.28 | 4 | 4 |
| | **UT4** | 0 | 1.9 | 3.3 | 15.6 | 32.1 | 26.9 | 20.3 | 5.40 | 1.18 | 5 | 5 |
| **ATU4** | **UT1** | 0 | 0.5 | 3.3 | 9.8 | 18.6 | 35.5 | 32.2 | 5.82 | 1.12 | 6 | 6 |
| | **UT2** | 4.3 | 8.7 | 21.7 | 17.4 | 21.7 | 21.7 | 4.3 | 4.26 | 1.57 | 4 | 3[a] |
| | **UT3** | 7.2 | 8.7 | 11.6 | 47.1 | 16.7 | 7.2 | 1.4 | 3.85 | 1.30 | 4 | 4 |
| | **UT4** | 0.5 | 0.9 | 5.2 | 20.8 | 25.9 | 26.9 | 19.8 | 5.31 | 1.25 | 5 | 6 |
| **ATU5** | **UT1** | 8.2 | 7.1 | 8.2 | 18 | 12.6 | 26.2 | 19.7 | 4.77 | 1.86 | 5 | 6 |
| | **UT2** | 0 | 0 | 8.7 | 4.3 | 21.7 | 21.7 | 43.5 | 5.87 | 1.29 | 6 | 7 |
| | **UT3** | 1.4 | 2.2 | 4.3 | 19.6 | 13.8 | 22.5 | 36.2 | 5.54 | 1.48 | 6 | 7 |
| | **UT4** | 1.4 | 2.8 | 3.8 | 17.5 | 16.5 | 23.6 | 34.4 | 5.53 | 1.47 | 6 | 7 |
| **ATU6** | **UT1** | 57.4 | 30.1 | 4.4 | 6.6 | 0.5 | 1.1 | 0 | 1.66 | 1 | 1 | 1 |
| | **UT2** | 26.1 | 21.7 | 13 | 17.4 | 13 | 4.3 | 4.3 | 3.00 | 1.78 | 3 | 1 |
| | **UT3** | 10.1 | 17.4 | 16.7 | 41.3 | 7.2 | 5.1 | 2.2 | 3.42 | 1.39 | 4 | 4 |
| | **UT4** | 33.5 | 35.8 | 12.3 | 16.5 | 0 | 1.4 | 0.5 | 3.17 | 1.2 | 2 | 2 |
| ***BI*** | ***Behavioural Intention*** | | | | | | | | | | | |
| **BI1** | **UT1** | 1.1 | 1.1 | 1.1 | 6.6 | 6.6 | 26.2 | 57.4 | 6.25 | 1.18 | 7 | 7 |
| | **UT2** | 13 | 21.7 | 13 | 43.5 | 0 | 0 | 8.7 | 3.30 | 1.61 | 4 | 4 |
| | **UT3** | 48.6 | 19.6 | 10.1 | 18.8 | 2.2 | 0 | 0.7 | 2.09 | 1.31 | 2 | 1 |

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| Code | User type | F1 | F2 | F3 | F4 | F5 | F6 | F7 | M | SD | Med | Mode |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | UT4 | 8.5 | 9 | 11.3 | 33 | 14.2 | 16 | 8 | 4.16 | 1.65 | 4 | 4 |
| BI2 | UT1 | 0.5 | 0.5 | 0.5 | 6.6 | 5.5 | 25.1 | 61.2 | 6.36 | 1.04 | 7 | 7 |
| | UT2 | 13 | 17.4 | 21.7 | 30.4 | 0 | 13 | 4.3 | 3.32 | 1.67 | 3 | 4 |
| | UT3 | 55.8 | 17.4 | 7.2 | 15.9 | 2.9 | 0.7 | 0 | 1.95 | 1.29 | 1 | 1 |
| | UT4 | 8.5 | 11.8 | 16.5 | 31.6 | 11.8 | 13.2 | 6.6 | 3.92 | 1.63 | 4 | 4 |
| BI3 | UT1 | 0.5 | 0.5 | 0.5 | 6 | 6.6 | 25.7 | 60.1 | 6.36 | 1.03 | 7 | 7 |
| | UT2 | 17.4 | 21.7 | 13 | 34.8 | 0 | 8.7 | 4.3 | 3.22 | 1.68 | 3 | 4 |
| | UT3 | 55.1 | 16.7 | 9.4 | 16.7 | 2.2 | 0 | 0 | 1.94 | 1.23 | 1 | 1 |
| | UT4 | 8 | 13.2 | 16 | 30.7 | 13.2 | 11.8 | 7.1 | 3.92 | 1.63 | 4 | 4 |
| ***USE*** | ***Use*** | | | | | | | | | | | |
| USE1 | UT1 | 0.5 | 6 | 9.3 | 24 | 23 | 13.7 | 23.5 | 4.98 | 1.53 | 5 | 4 |
| | UT2 | 47.8 | 30.4 | 8.7 | 13 | 0 | 0 | 0 | 1.87 | 1.06 | 2 | 1 |
| | UT3 | 24.6 | 21 | 16.7 | 33.3 | 2.9 | 1.4 | 0 | 2.73 | 1.31 | 3 | 4 |
| | UT4 | 1.9 | 7.5 | 17 | 39.2 | 18.9 | 11.3 | 4.2 | 4.17 | 1.28 | 4 | 4 |
| USE2 | UT1 | 0 | 1.1 | 3.3 | 14.8 | 16.4 | 21.9 | 42.6 | 5.83 | 1.28 | 6 | 7 |
| | UT2 | 26.1 | 13 | 30.4 | 21.7 | 8.7 | 0 | 0 | 2.74 | 1.32 | 3 | 3 |
| | UT3 | 17.4 | 15.2 | 16.7 | 32.6 | 10.1 | 5.8 | 2.2 | 3.29 | 1.54 | 4 | 4 |
| | UT4 | 0 | 0.5 | 8 | 26.9 | 23.6 | 26.4 | 14.6 | 4.13 | 1.22 | 5 | 4 |
| USE3 | UT1 | 0 | 0.5 | 1.6 | 14.8 | 19.1 | 27.3 | 36.6 | 5.81 | 1.16 | 6 | 7 |
| | UT2 | 8.7 | 26.1 | 21.7 | 26.1 | 4.3 | 4.3 | 8.7 | 3.39 | 1.67 | 3 | 2[a] |
| | UT3 | 8 | 12.3 | 14.5 | 29.7 | 21.7 | 10.9 | 2.9 | 3.89 | 1.51 | 4 | 4 |
| | UT4 | 0 | 0.5 | 5.2 | 17.5 | 19.3 | 33 | 24.5 | 4.54 | 1.21 | 6 | 6 |
| ***PIIT*** | ***Personal Innovativeness in IT*** | | | | | | | | | | | |
| PIIT1 | UT1 | 0.5 | 4.9 | 11.5 | 19.1 | 27.9 | 20.8 | 15.3 | 4.92 | 1.42 | 5 | 5 |
| | UT2 | 4.3 | 30.4 | 8.7 | 13 | 8.7 | 13 | 21.7 | 4.17 | 2.10 | 4 | 2 |
| | UT3 | 13 | 16.7 | 13 | 31.2 | 14.5 | 6.5 | 5.1 | 3.57 | 1.63 | 4 | 4 |
| | UT4 | 2.8 | 10.8 | 9.4 | 23.6 | 22.2 | 19.8 | 11.3 | 4.56 | 1.59 | 5 | 4 |
| PIIT2 | UT1 | 6 | 10.9 | 11.5 | 27.9 | 19.1 | 14.8 | 9.8 | 4.27 | 1.64 | 4 | 4 |
| | UT2 | 21.7 | 21.7 | 13 | 8.7 | 8.7 | 17.4 | 8.7 | 3.48 | 2.11 | 3 | 1[a] |
| | UT3 | 25.4 | 23.2 | 13 | 22.5 | 5.8 | 7.2 | 2.9 | 2.93 | 1.68 | 3 | 1 |
| | UT4 | 12.7 | 17.9 | 14.6 | 22.2 | 12.7 | 13.7 | 6.1 | 3.70 | 1.78 | 4 | 4 |
| PIIT3 | UT1 | 4.4 | 8.2 | 10.9 | 21.9 | 21.3 | 19.1 | 14.2 | 4.62 | 1.65 | 5 | 4 |
| | UT2 | 13 | 26.1 | 21.7 | 4.3 | 8.7 | 17.4 | 8.7 | 3.57 | 2.00 | 3 | 2 |
| | UT3 | 23.2 | 18.8 | 12.3 | 27.5 | 8.7 | 6.5 | 2.9 | 3.11 | 1.67 | 3 | 4 |
| | UT4 | 9 | 13.7 | 14.6 | 18.4 | 16.5 | 16.5 | 11.3 | 4.15 | 1.83 | 4 | 4 |
| PIIT4 | UT1 | 42.6 | 28.4 | 9.3 | 12.6 | 5.5 | 1.6 | 0 | 2.15 | 1.33 | 2 | 1 |
| | UT2 | 30.4 | 13 | 13 | 26.1 | 4.3 | 8.7 | 4.3 | 3.04 | 1.85 | 3 | 1 |
| | UT3 | 18.1 | 17.4 | 14.5 | 20.3 | 10.9 | 14.5 | 4.3 | 3.49 | 1.82 | 3.5 | 4 |
| | UT4 | 23.1 | 29.2 | 10.4 | 19.3 | 7.1 | 6.6 | 4.2 | 2.95 | 1.73 | 2 | 2 |
| ***M*** | ***Motivation*** | | | | | | | | | | | |
| M1 | UT1 | 0 | 1.1 | 1.6 | 9.8 | 14.8 | 34.4 | 38.3 | 5.95 | 1.12 | 6 | 7 |
| | UT2 | 8.7 | 0 | 21.7 | 17.4 | 17.4 | 21.7 | 13 | 4.52 | 1.76 | 5 | 3[a] |
| | UT3 | 7.2 | 10.1 | 13 | 25.4 | 21.7 | 16.7 | 5.8 | 4.17 | 1.61 | 4 | 4 |
| | UT4 | 0.5 | 0 | 1.4 | 15.6 | 17.9 | 39.6 | 25 | 4.71 | 1.10 | 6 | 6 |
| M2 | UT1 | 10.9 | 9.3 | 6.6 | 28.4 | 15.3 | 17.5 | 12 | 4.28 | 1.82 | 4 | 4 |
| | UT2 | 30.4 | 13 | 8.7 | 21.7 | 8.7 | 8.7 | 8.7 | 3.26 | 2.05 | 3 | 1 |
| | UT3 | 34.8 | 14.5 | 11.6 | 31.9 | 3.6 | 2.9 | 0.7 | 2.67 | 1.51 | 3 | 1 |
| | UT4 | 11.3 | 9 | 13.2 | 38.7 | 11.3 | 12.3 | 4.2 | 3.83 | 1.58 | 4 | 4 |
| M3 | UT1 | 1.6 | 5.5 | 10.9 | 20.2 | 20.8 | 24 | 16.9 | 4.93 | 1.52 | 5 | 6 |
| | UT2 | 30.4 | 8.7 | 8.7 | 17.4 | 17.4 | 8.7 | 8.7 | 3.43 | 2.09 | 4 | 1 |
| | UT3 | 23.2 | 13.8 | 10.9 | 35.5 | 9.4 | 5.1 | 2.2 | 3.18 | 1.61 | 4 | 4 |
| | UT4 | 3.3 | 2.4 | 8 | 39.2 | 20.8 | 19.8 | 6.6 | 4.58 | 1.32 | 4 | 4 |

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| Code | User type | F1 | F2 | F3 | F4 | F5 | F6 | F7 | M | SD | Med | Mode |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **M4** | **UT1** | 2.7 | 4.9 | 8.2 | 24 | 21.3 | 25.7 | 13.1 | 4.86 | 1.49 | 5 | 6 |
| | **UT2** | 17.4 | 17.4 | 17.4 | 13 | 8.7 | 17.4 | 8.7 | 3.65 | 2.01 | 3 | 1[a] |
| | **UT3** | 26.8 | 19.6 | 13.8 | 31.9 | 5.8 | 2.2 | 0 | 3.66 | 1.41 | 3 | 4 |
| | **UT4** | 1.9 | 6.1 | 10.4 | 37.3 | 17.9 | 20.8 | 5.7 | 4.48 | 1.35 | 4 | 4 |
| **M5** | **UT1** | 5.5 | 12 | 5.5 | 26.2 | 16.9 | 20.8 | 13.1 | 4.52 | 1.72 | 5 | 4 |
| | **UT2** | 21.7 | 13 | 4.3 | 21.7 | 13 | 21.7 | 4.3 | 3.74 | 2.01 | 4 | 1[a] |
| | **UT3** | 30.4 | 19.6 | 10.9 | 27.5 | 8.7 | 2.9 | 0 | 3.73 | 1.50 | 2.5 | 1 |
| | **UT4** | 3.8 | 6.1 | 8.5 | 31.6 | 20.8 | 22.6 | 6.6 | 4.54 | 1.45 | 4.5 | 4 |
| ***PPI*** | ***Perceived Pedagogical Impact*** | | | | | | | | | | | |
| **PPI1** | **UT1** | 0.5 | 1.6 | 1.1 | 11.5 | 15.8 | 42.1 | 27.3 | 5.76 | 1.16 | 6 | 6 |
| | **UT2** | 4.3 | 4.3 | 8.7 | 13 | 21.7 | 26.1 | 21.7 | 5.09 | 1.68 | 5 | 6 |
| | **UT3** | 6.5 | 6.5 | 8 | 37 | 16.7 | 17.4 | 8 | 4.35 | 1.55 | 4 | 4 |
| | **UT4** | 0.9 | 2.8 | 2.4 | 24.5 | 20.8 | 30.7 | 17.9 | 5.25 | 1.31 | 5 | 6 |
| **PPI2** | **UT1** | 0 | 3.3 | 6.6 | 12.6 | 19.7 | 35.5 | 22.4 | 5.45 | 1.32 | 6 | 6 |
| | **UT2** | 4.3 | 4.3 | 8.7 | 21.7 | 30.4 | 17.4 | 13 | 4.74 | 1.54 | 5 | 5 |
| | **UT3** | 8 | 6.5 | 12.3 | 34.8 | 26.1 | 7.2 | 5.1 | 4.07 | 1.46 | 4 | 4 |
| | **UT4** | 0.9 | 1.4 | 6.1 | 22.2 | 21.7 | 36.8 | 10.8 | 5.16 | 1.24 | 5 | 6 |
| **PPI3** | **UT1** | 2.2 | 2.7 | 7.1 | 19.1 | 27.3 | 27.9 | 13.7 | 5.05 | 1.38 | 5 | 6 |
| | **UT2** | 21.7 | 4.3 | 13 | 30.4 | 13 | 4.3 | 13 | 3.74 | 1.96 | 4 | 4 |
| | **UT3** | 10.1 | 9.4 | 12.3 | 37 | 18.8 | 9.4 | 2.9 | 3.85 | 1.49 | 4 | 4 |
| | **UT4** | 0.9 | 4.7 | 9.9 | 28.8 | 24.5 | 22.6 | 8.5 | 4.73 | 1.33 | 5 | 4 |
| **PPI4** | **UT1** | 1.1 | 5.5 | 7.7 | 25.1 | 21.9 | 29 | 9.8 | 4.87 | 1.38 | 5 | 6 |
| | **UT2** | 8.7 | 17.4 | 13 | 34.8 | 21.7 | 0 | 4.3 | 3.61 | 1.47 | 4 | 4 |
| | **UT3** | 10.1 | 7.2 | 12.3 | 39.1 | 15.2 | 10.1 | 5.8 | 3.96 | 1.56 | 4 | 4 |
| | **UT4** | 0.9 | 2.8 | 9 | 27.8 | 25.5 | 24.5 | 9.4 | 4.85 | 1.29 | 5 | 4 |
| **PPI5** | **UT1** | 0.5 | 1.1 | 4.9 | 12.6 | 22.4 | 36.6 | 21.9 | 5.52 | 1.22 | 6 | 6 |
| | **UT2** | 0 | 4.3 | 4.3 | 34.8 | 34.8 | 13 | 8.7 | 4.74 | 1.18 | 5 | 4[a] |
| | **UT3** | 8 | 8.7 | 10.9 | 33.3 | 23.9 | 10.9 | 4.3 | 4.07 | 1.50 | 4 | 4 |
| | **UT4** | 0.5 | 0.9 | 4.7 | 25.9 | 23.1 | 32.1 | 12.7 | 5.17 | 1.19 | 5 | 6 |
| **PPI6** | **UT1** | 1.6 | 3.3 | 4.9 | 22.4 | 31.1 | 29.5 | 7.1 | 4.95 | 1.25 | 5 | 5 |
| | **UT2** | 8.7 | 17.4 | 17.4 | 30.4 | 21.7 | 0 | 4.3 | 3.57 | 1.47 | 4 | 4 |
| | **UT3** | 9.4 | 12.3 | 16.7 | 41.3 | 13.8 | 3.6 | 2.9 | 3.60 | 1.38 | 4 | 4 |
| | **UT4** | 2.4 | 1.4 | 11.3 | 36.8 | 21.7 | 19.8 | 6.6 | 4.60 | 1.28 | 4 | 4 |
| **PPI7** | **UT1** | 1.6 | 6 | 10.9 | 22.4 | 28.4 | 22.4 | 8.2 | 4.70 | 1.39 | 5 | 5 |
| | **UT2** | 8.7 | 17.4 | 13 | 17.4 | 21.7 | 8.7 | 13 | 4.04 | 1.87 | 4 | 5 |
| | **UT3** | 8.7 | 12.3 | 15.2 | 44.9 | 12.3 | 3.6 | 2.9 | 3.62 | 1.35 | 4 | 4 |
| | **UT4** | 1.4 | 2.8 | 9 | 31.6 | 27.8 | 19.8 | 7.5 | 4.71 | 1.26 | 5 | 4 |
| **PPI8** | **UT1** | 2.2 | 4.9 | 10.4 | 24.6 | 29 | 20.2 | 8.7 | 4.69 | 1.39 | 5 | 5 |
| | **UT2** | 13 | 8.7 | 17.4 | 21.7 | 21.7 | 8.7 | 8.7 | 3.91 | 1.78 | 4 | 4[a] |
| | **UT3** | 8.7 | 13 | 19.6 | 40.6 | 9.4 | 4.3 | 4.3 | 3.59 | 1.42 | 4 | 4 |
| | **UT4** | 0.9 | 4.7 | 8 | 34 | 26.4 | 21.2 | 4.7 | 4.63 | 1.23 | 5 | 4 |

*Note. a. Multiple modes exist. The smallest value is shown.*

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**Appendix D. Post-hoc analysis (UT1 current users, UT2 former users, UT3 non-planning nonusers, UT4 planning nonuser)**

| Code | Diff UT1 – UT2* / $n_1$ = 183, $n_2$ = 23, N = 206 | | | | | | Diff UT1 – UT3* / $n_1$ = 183, $n_3$ = 138, N = 321 | | | | | Diff UT1 – UT4* / $n_1$ = 183, $n_4$ = 212, N = 395 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | U | sig. | Z | Asymp. Sig (2-tailed) | effect size (r) | Inter. | U | Z | Asymp. sig. (2-tailed) | effect size (r) | Inter. | U | Z | Asymp. sig. (2-tailed) | effect size (r) | Inter. |
| PE1 | 1338.50 | .004 | 2.84 | .004 | .20 | S | 3967.50 | 10.52 | .000 | .59 | **L** | 14900.50 | 3.97 | .000 | .20 | S |
| PE2 | 757.00 | .000 | 5.00 | .000 | .35 | M | 4323.00 | 10.09 | .000 | .56 | **L** | 15127.00 | 3.77 | .000 | .19 | S |
| PE3 | 750.00 | .000 | 5.02 | .000 | .35 | M | 4390.00 | 10.01 | .000 | .56 | **L** | 15238.00 | 3.68 | .000 | .18 | S |
| EE1 | 1574.00 | .049 | 1.97 | .049 | .14 | S | 7774.00 | 5.89 | .000 | .33 | M | 17878.50 | 1.34 | .179 | .07 | / |
| EE2 | 1610.00 | .067 | 1.83 | .067 | .13 | S | 6681.50 | 7.22 | .000 | .40 | M | 16524.50 | 2.54 | .011 | .13 | S |
| EE3 (R) | 1832.00 | .315 | 1.01 | .313 | .07 | / | 8371.50 | 5.17 | .000 | .29 | S | 16024.50 | 2.98 | .003 | .15 | S |
| FC1 | 1489.00 | .022 | 2.28 | .022 | .16 | S | 5522.00 | 8.63 | .000 | .48 | M | 12621.50 | 5.99 | .000 | .30 | M |
| FC2 | 1414.50 | .010 | 2.56 | .011 | .18 | S | 6241.00 | 7.76 | .000 | .43 | M | 14265.50 | 4.54 | .000 | .23 | S |
| FC3 | 1830.00 | .311 | -1.02 | .309 | .07 | / | 7616.00 | 6.09 | .000 | .34 | M | 16423.00 | 2.63 | .009 | .13 | S |
| SI1 | 1033.50 | .000 | 3.97 | .000 | .28 | S | 5697.00 | 8.42 | .000 | .47 | M | 14348.50 | 4.46 | .000 | .22 | S |
| SI2 | 767.50 | .000 | 4.96 | .000 | .35 | M | 5054.50 | 9.20 | .000 | .51 | **L** | 13789.00 | 4.96 | .000 | .25 | S |
| SI3 | 1056.00 | .000 | 3.89 | .000 | .27 | S | 5892.50 | 8.18 | .000 | .46 | M | 15726.50 | 3.24 | .001 | .16 | S |
| SI4 | 1448.00 | .014 | 2.43 | .015 | .17 | S | 7751.00 | 5.92 | .000 | .33 | M | 17374.00 | 1.79 | .074 | .09 | / |
| SI5 | 1392.50 | .008 | 2.64 | .008 | .18 | S | 7234.50 | 6.55 | .000 | .37 | M | 15839.00 | 3.14 | .002 | .16 | S |
| SI6 | 1280.50 | .002 | 3.06 | .002 | .21 | S | 6546.50 | 7.39 | .000 | .41 | M | 14547.50 | 4.29 | .000 | .22 | S |
| SI7 | 1033.50 | .000 | 3.97 | .000 | .28 | S | 5664.00 | 8.46 | .000 | .47 | M | 15468.00 | 3.47 | .001 | .17 | S |
| SI8 | 1259.50 | .001 | 3.13 | .002 | .22 | S | 7946.50 | 5.69 | .000 | .32 | M | 19290.00 | 0.10 | .924 | .00 | / |
| ATU1 (R) | 1096.00 | .000 | 3.74 | .000 | .26 | S | 3938.00 | 10.55 | .000 | .59 | **L** | 13310.00 | 5.38 | .000 | .27 | S |
| ATU2 | 1344.50 | .004 | 2.82 | .005 | .20 | S | 3916.00 | 10.58 | .000 | .59 | **L** | 15692.00 | 3.27 | .001 | .16 | S |
| ATU3 | 1075.50 | .000 | 3.82 | .000 | .27 | S | 4355.50 | 10.05 | .000 | .56 | **L** | 16923.50 | 2.19 | .029 | .11 | S |
| ATU4 | 906.00 | .000 | 4.45 | .000 | .31 | M | 3298.00 | 11.33 | .000 | .63 | **L** | 14721.50 | 4.13 | .000 | .21 | S |
| ATU5 (R) | 1376.00 | .006 | 2.70 | .007 | .19 | S | 9629.50 | 3.64 | .000 | .20 | S | 14901.50 | 3.97 | .000 | .20 | S |
| ATU6 (R) | 1137.00 | .000 | 3.59 | .000 | .25 | S | 4021.00 | 10.45 | .000 | .58 | **L** | 13915.50 | 4.84 | .000 | .24 | S |
| BI1 | 414.00 | .000 | 6.27 | .000 | .44 | M | 732.50 | 14.45 | .000 | .81 | **L** | 5809.50 | 12.01 | .000 | .60 | **L** |
| BI2 | 354.00 | .000 | 6.49 | .000 | .45 | M | 425.50 | 14.82 | .000 | .83 | **L** | 4359.00 | 13.29 | .000 | .67 | **L** |
| BI3 | 312.00 | .000 | 6.65 | .000 | .46 | M | 360.50 | 14.90 | .000 | .83 | **L** | 4405.50 | 13.25 | .000 | .67 | **L** |
| USE1 | 245.00 | .000 | 6.90 | .000 | .48 | M | 3654.00 | 10.90 | .000 | .61 | **L** | 13350.50 | 5.34 | .000 | .27 | S |
| USE2 | 245.50 | .000 | 6.90 | .000 | .48 | M | 2915.50 | 11.80 | .000 | .66 | **L** | 13035.50 | 5.62 | .000 | .28 | S |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | U | sig. | Z | Asymp. Sig (2-tailed) | effect size (r) | Inter. | U | Z | Asymp. sig. (2-tailed) | effect size (r) | Inter. | U | Z | Asymp. sig. (2-tailed) | effect size (r) | Inter. |
| USE3 | 559.00 | .000 | 5.73 | .000 | .40 | M | 4194.00 | 10.24 | .000 | .57 | **L** | 16808.00 | 2.29 | .022 | .12 | S |
| PIIT1 | 1661.50 | .100 | 1.64 | .101 | .11 | S | 6827.00 | 7.05 | .000 | .39 | M | 17033.0 | 2.09 | .036 | .11 | S |
| PIIT2 | 1607.00 | .065 | 1.84 | .065 | .13 | S | 7189.00 | 6.61 | .000 | .37 | M | 15784.50 | 3.19 | .001 | .16 | S |
| PIIT3 | 1436.00 | .013 | 2.48 | .013 | .17 | S | 6651.50 | 7.26 | .000 | .41 | M | 16555.50 | 2.51 | .012 | .13 | S |
| PIIT4 (R) | 1536.50 | .034 | 2.11 | .035 | .15 | S | 7222.00 | 6.57 | .000 | .37 | M | 14078.50 | 4.70 | .000 | .24 | S |
| M1 | 1071.00 | .000 | 3.83 | .000 | .27 | S | 4720.50 | 9.60 | .000 | .54 | **L** | 16549.50 | 2.52 | .012 | .13 | S |
| M2 | 1480.50 | .020 | 2.31 | .021 | .16 | S | 6365.00 | 7.61 | .000 | .42 | M | 16213.50 | 2.81 | .005 | .14 | S |
| M3 | 1229.50 | .001 | 3.25 | .001 | .23 | S | 5638.00 | 8.49 | .000 | .47 | M | 16437.00 | 2.62 | .009 | .13 | S |
| M4 | 1356.00 | .005 | 2.78 | .006 | .19 | S | 4148.00 | 10.30 | .000 | .57 | **L** | 16164.50 | 2.86 | .004 | .14 | S |
| M5 | 1642.50 | .086 | 1.71 | .087 | .12 | S | 5666.00 | 8.46 | .000 | .47 | M | 19157.00 | 0.21 | .832 | .01 | / |
| PPI1 | 1627.00 | .077 | 1.77 | .077 | .12 | S | 5884.00 | 8.19 | .000 | .46 | M | 14871.50 | 4.00 | .000 | .20 | S |
| PPI2 | 1513.00 | .028 | 2.19 | .028 | .15 | S | 6003.50 | 8.05 | .000 | .45 | M | 16544.00 | 2.52 | .012 | .13 | S |
| PPI3 | 1229.50 | .001 | 3.25 | .001 | .23 | S | 6927.00 | 6.92 | .000 | .39 | M | 16497.00 | 2.56 | .010 | .13 | S |
| PPI4 | 1113.00 | .000 | 3.68 | .000 | .26 | S | 8316.00 | 5.24 | .000 | .29 | S | 18946.00 | 0.40 | .690 | .02 | / |
| PPI5 | 1296.00 | .002 | 3.00 | .003 | .21 | S | 5675.00 | 8.44 | .000 | .47 | M | 15938.50 | 3.06 | .002 | .15 | S |
| PPI6 | 964.50 | .000 | 4.23 | .000 | .29 | S | 5710.00 | 8.40 | .000 | .47 | M | 15854.50 | 3.13 | .002 | .16 | S |
| PPI7 PPI8 | 1653.50 | .094 | 1.67 | .095 | .12 | S | 7202.00 | 6.59 | .000 | .37 | M | 19125.00 | 0.24 | .810 | .01 | / |
| PI8 | 1550.00 | .039 | 2.06 | .040 | .14 | S | 7123.00 | 6.69 | .000 | .37 | M | 18624.00 | 0.68 | .494 | .03 | / |

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| Code | Diff UT2 – UT3*/ $n_2$ = 23, $n_3$ = 138, N = 161 | | | | | | Diff UT2 – UT4*/ $n_2$ = 23, $n_4$ = 212, N = 235 | | | | | | Diff UT3 – UT4*/ $n_3$ = 138, $n_4$ = 212, N = 350 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | U | sig. | Z | Asymp. sig. (2-tailed) | effect size (r) | Int. | U | sig. | Z | Asymp. sig. (2-tailed) | effect size (r) | Int. | U | Z | Asymp. sig. (2-tailed) | effect size (r) | Int. |
| PE1 | 864.50 | .000 | 3.49 | .000 | .27 | S | 2045.50 | .206 | -1.27 | .206 | .08 | / | 6058.50 | -9.26 | .000 | .50 | M |
| PE2 | 1583.00 | .987 | -0.02 | .987 | .00 | / | 1236.00 | .000 | -3.88 | .000 | .25 | S | 7242.50 | -7.98 | .000 | .43 | M |
| PE3 | 1554.00 | .876 | 0.16 | .875 | .01 | / | 1231.00 | .000 | -3.90 | .000 | .25 | S | 7182.00 | -8.05 | .000 | .43 | M |
| EE1 | 1365.00 | .287 | 1.07 | .285 | .08 | / | 2043.50 | .204 | -1.27 | .203 | .08 | / | 10176.50 | -4.81 | .000 | .26 | S |
| EE2 | 1181.50 | .050 | 1.96 | .050 | .15 | S | 2239.50 | .524 | -0.64 | .523 | .04 | / | 9866.50 | -5.15 | .000 | .28 | S |
| EE3 (R) | 1277.00 | .136 | 1.50 | .135 | .12 | S | 2344.50 | .764 | 0.30 | .764 | .02 | / | 12205.50 | -2.62 | .009 | .14 | S |
| FC1 | 1236.50 | .091 | 1.69 | .091 | .13 | S | 2416.50 | .945 | -0.07 | .946 | .00 | / | 10909.50 | -4.02 | .000 | .21 | S |
| FC2 | 1302.50 | .170 | 1.37 | .170 | .11 | S | 2209.50 | .463 | -0.74 | .462 | .05 | / | 10638.50 | -4.31 | .000 | .23 | S |
| FC3 | 789.00 | .000 | 3.85 | .000 | .30 | M | 1770.00 | .030 | 2.16 | .031 | .14 | S | 11136.50 | -3.77 | .000 | .20 | S |
| SI1 | 1554.50 | .876 | 0.15 | .877 | .01 | / | 1679.50 | .014 | -2.45 | .014 | .16 | S | 9519.50 | -5.52 | .000 | .30 | S |
| SI2 | 1527.00 | .775 | -0.29 | .774 | .02 | / | 1388.50 | .001 | -3.39 | .001 | .22 | S | 8992.00 | -6.09 | .000 | .33 | M |
| SI3 | 1489.50 | .640 | 0.47 | .639 | .04 | / | 1651.50 | .010 | -2.54 | .011 | .17 | S | 9268.00 | -5.79 | .000 | .31 | M |
| SI4 | 1517.00 | .739 | 0.34 | .737 | .03 | / | 1881.00 | .072 | -1.80 | .072 | .12 | S | 10200.50 | -4.79 | .000 | .26 | S |
| SI5 | 1462.50 | .550 | 0.60 | .549 | .05 | / | 2057.00 | .221 | -1.23 | .219 | .08 | / | 11051.00 | -3.87 | .000 | .21 | S |
| SI6 | 1440.00 | .482 | 0.71 | .479 | .06 | / | 1979.00 | .139 | -1.48 | .139 | .10 | / | 10479.50 | -4.48 | .000 | .24 | S |
| SI7 | 1522.50 | .757 | 0.31 | .757 | .02 | / | 1575.50 | .005 | -2.78 | .005 | .18 | S | 8826.50 | -6.27 | .000 | .34 | M |
| SI8 | 1529.50 | .783 | -0.28 | .783 | .02 | / | 1500.00 | .002 | -3.03 | .002 | .20 | S | 9385.00 | -5.67 | .000 | .30 | M |
| ATU1 (R) | 1220.50 | .077 | 1.77 | .077 | .14 | S | 1836.00 | .052 | -1.94 | .052 | .13 | S | 7379.50 | -7.84 | .000 | .42 | M |
| ATU2 | 1055.50 | .010 | 2.57 | .010 | .20 | S | 1961.00 | .124 | -1.54 | .124 | .10 | S | 6507.50 | -8.78 | .000 | .47 | M |
| ATU3 | 1255.00 | .110 | 1.60 | .109 | .13 | S | 1517.50 | .003 | -2.97 | .003 | .19 | S | 6459.50 | -8.83 | .000 | .47 | M |
| ATU4 | 1340.50 | .235 | 1.19 | .235 | .09 | / | 1517.00 | .003 | -2.97 | .003 | .19 | S | 6268.50 | -9.04 | .000 | .48 | M |
| ATU5 (R) | 1403.50 | .378 | -0.88 | .377 | .07 | / | 2132.00 | .326 | -0.99 | .324 | .06 | / | 14531.00 | -0.10 | .917 | .01 | / |
| ATU6 (R) | 1315.50 | .191 | 1.31 | .190 | .10 | S | 1831.00 | .050 | -1.96 | .050 | .13 | S | 7423.50 | -7.79 | .000 | .42 | M |
| BI1 | 883.00 | .001 | 3.40 | .001 | .27 | S | 1678.50 | .014 | -2.45 | .014 | .16 | S | 5169.00 | -10.22 | .000 | .55 | **L** |
| BI2 | 768.00 | .000 | 3.95 | .000 | .31 | M | 1989.00 | .148 | -1.45 | .148 | .09 | / | 5297.00 | -10.09 | .000 | .54 | **L** |
| BI3 | 866.00 | .000 | 3.48 | .001 | .27 | S | 1840.50 | .053 | -1.93 | .054 | .13 | S | 5203.50 | -10.19 | .000 | .54 | **L** |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | U | sig. | Z | Asymp. sig. (2-tailed) | effect size (r) | Int. | U | sig. | Z | Asymp. sig. (2-tailed) | effect size (r) | Int. | U | Z | Asymp. sig. (2-tailed) | effect size (r) | Int. |
| USE1 | 1002.50 | .004 | -2.82 | .005 | .22 | S | 474.50 | .000 | -6.34 | .000 | .41 | M | 6793.00 | -8.47 | .000 | .45 | M |
| USE2 | 1263.50 | .119 | -1.56 | .119 | .12 | S | 500.50 | .000 | -6.26 | .000 | .41 | M | 5535.00 | -9.83 | .000 | .53 | **L** |
| USE3 | 1231.50 | .086 | -1.71 | .086 | .14 | S | 785.00 | .000 | -5.34 | .000 | .35 | M | 6093.00 | -9.23 | .000 | .49 | M |
| PIIT1 | 1341.00 | .237 | 1.19 | .236 | .09 | / | 2171.50 | .392 | -0.86 | .390 | .06 | / | 9693.50 | -5.33 | .000 | .29 | S |
| PIIT2 | 1374.50 | .307 | 1.02 | .306 | .08 | / | 2240.00 | .526 | -0.64 | .524 | .04 | / | 11017.00 | -3.90 | .000 | .21 | S |
| PIIT3 | 1401.50 | .373 | 0.89 | .371 | .07 | / | 1998.50 | .157 | -1.42 | .156 | .09 | / | 9958.00 | -5.05 | .000 | .27 | S |
| PIIT4 (R) | 1357.00 | .269 | 1.11 | .268 | .09 | / | 2396.50 | .894 | -0.13 | .895 | .01 | / | 12098.00 | -2.73 | .006 | .15 | S |
| M1 | 1398.50 | .365 | 0.91 | .364 | .07 | / | 1461.00 | .001 | -3.15 | .002 | .21 | S | 6636.50 | -8.64 | .000 | .46 | M |
| M2 | 1344.00 | .243 | 1.17 | .241 | .09 | / | 1983.50 | .143 | -1.47 | .143 | .10 | / | 8878.50 | -6.21 | .000 | .33 | M |
| M3 | 1478.00 | .602 | 0.52 | .600 | .04 | / | 1666.50 | .012 | -2.49 | .013 | .16 | S | 7650.50 | -7.54 | .000 | .40 | M |
| M4 | 1205.00 | .065 | 1.84 | .065 | .15 | S | 1795.50 | .037 | -2.07 | .038 | .14 | S | 5973.50 | -9.36 | .000 | .50 | **L** |
| M5 | 1109.00 | .020 | 2.31 | .021 | .18 | S | 1915.00 | .092 | -1.69 | .092 | .11 | S | 5996.50 | -9.33 | .000 | .50 | M |
| PPI1 | 1135.50 | .029 | 2.18 | .029 | .17 | S | 2393.00 | .886 | -0.14 | .886 | .01 | / | 9678.50 | -5.35 | .000 | .29 | S |
| PPI2 | 1162.50 | .040 | 2.05 | .041 | .16 | S | 2052.50 | .215 | -1.24 | .214 | .08 | / | 8301.50 | -6.84 | .000 | .37 | M |
| PPI3 | 1508.00 | .706 | -0.38 | .705 | .03 | / | 1663.00 | .012 | -2.50 | .012 | .16 | S | 9868.00 | -5.15 | .000 | .28 | S |
| PPI4 | 1393.00 | .352 | -0.93 | .350 | .07 | / | 1293.50 | .000 | -3.69 | .000 | .24 | S | 9725.50 | -5.30 | .000 | .28 | S |
| PPI5 | 1191.00 | .056 | 1.91 | .056 | .15 | S | 1924.00 | .097 | -1.66 | .097 | .11 | S | 8521.00 | -6.60 | .000 | .35 | M |
| PPI6 | 1569.00 | .933 | -0.08 | .933 | .01 | / | 1478.00 | .002 | -3.10 | .002 | .20 | S | 8882.00 | -6.21 | .000 | .33 | M |
| PPI7 | 1364.00 | .284 | 1.07 | .282 | .08 | / | 1913.00 | .090 | -1.69 | .090 | .11 | S | 8129.00 | -7.02 | .000 | .38 | M |
| PPI8 | 1389.50 | .342 | 0.95 | .341 | .08 | / | 1842.00 | .054 | -1.92 | .054 | .13 | S | 8327.50 | -6.81 | .000 | .36 | M |

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