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DIFFERENCES IN CHEMISTRY TEACHERS' ACCEPTANCE OF EDUCATIONAL SOFTWARE ACCORDING TO THEIR USER TYPE: AN APPLICATION OF EXTENDED UTAUT MODEL

Kateřina Chroustová, Andrej Šorgo, Martin Bílek, Martin Rusek

Abstract. *In this research, a model to determine chemistry teachers' acceptance of educational software in secondary education is proposed. The model extends the unified theory of acceptance and use of technology (UTAUT) model. Data were collected from 556 Czech chemistry teachers and analysed using structural equation modelling. With respect to the significant differences among technology users and various types of nonusers, the research model for each user group was tested too. The results showed significant differences in the individual models for each group of technology user. In the model for 'current users' of educational software, the influence of facilitating conditions on current users' use of educational software behavioural intention is stressed. In addition, non-planning users' behavioural intention seems to be influenced by their personal innovativeness in IT, social influence, and performance expectancy. Behavioural intention and attitude towards using educational software affect each of the tested models, with attitudes being an even stronger predictor of educational software usage than behavioural intention. The models contribute to the understanding of teachers' acceptance of educational software, which can be utilized in both pre- and in-service teacher training, considering technology mastery a necessary teacher competence.*

Keywords: *chemistry teachers' motivation, educational software use, secondary education, technology acceptance*

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Introduction

Educational software (EduSW) is probably the most appropriate answer to the question of how to introduce information and communication technology (ICT) for educational purposes, rather than a modern 'toy' that parents, learners, and teachers simply think it is. As chemistry is a complex subject at the macro, (sub)micro, and symbolic (Johnstone, 1991) levels, combining theoretical content with practical work, EduSW for chemistry education is mostly designed to support display of these levels (e.g., Marson & Torres, 2011) and supplement experimental activities (e.g., Alkan & Koçak, 2015; Ramadhan & Irwanto, 2017).

However, the introduction of educational technology into the classroom can come with hesitancy, resulting in suboptimal technology use for productive teaching and learning. The first step for any technology to be used in the classroom is the intention to use it, which precedes its acceptance, testing, and based on teachers' experiences, its continued or abandoned use.

Technology acceptance is defined as the demonstrable willingness within a user group to use technology for the tasks for which it was created (Dillon & Morris, 1996). The concept of acceptance is understood to be at the end of the process (and an output variable in the explanatory models) that users go through when deciding whether to accept technology. According to information technology acceptance theories (e.g., Dillon & Morris, 1996; Venkatesh et al., 2003), the process can be modelled and predicted by the user for its intended purposes. Some of the most often used theories and models are introduced in the theoretical section.

Although there are several studies investigating the effectiveness of EduSW (see e.g., Tatli & Ayas, 2013; Yang et al., 2004), research focusing on

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teachers' acceptance of EduSW is still limited. If the factors that influence the acceptance and use of EduSW were known, resistance or rejection of the use of the technology could be minimized by influencing them, and subsequently teachers could integrate the technology effectively into chemistry education.

Research Problem

EduSW is intended to be used in chemistry education as the actual agent of change, but its potential cannot be fully developed if teachers do not accept it and do not use it (Chroustová et al., 2015). Although a range of high-quality EduSW is available for chemistry education focused on various thematic areas (e.g., atom structure, chemical bonding, chemical nomenclature, electrochemistry, etc.), it is relatively rarely used in chemistry in practice (Chroustová, 2018). The decision to integrate EduSW into chemistry education and its acceptance by the chemistry teacher can be influenced by a number of factors. The purpose of the research was to identify these factors and to determine their degree of influence with respect to differences between teachers according to their user type through an application of extended model of the unified theory of acceptance and use of technology (UTAUT) which was also modified for different types of users. The results explain the acceptance of EduSW by chemistry teachers as a unified group, and also for different types of users. Such knowledge can contribute to pre-service teachers' training in terms of technological and pedagogical content knowledge – TPACK (Mishra & Koehler, 2006) development as well as to support in-service teachers in their further development.

Research Questions

The research was guided by the research questions which follow.

- RQ1: What factors influence the acceptance and use of EduSW by teachers in chemistry education?
- RQ2: How do the factors found in RQ1 affect each other?
- RQ3: Which factors affect certain groups of teachers – technology users and how can they be used in EduSW's promotion?

Theoretical Framework

ICT in Chemistry Education

Despite its quite long tradition, educational technology research is the least frequently addressed in science education research (Lin et al., 2018) and, more specifically, in chemistry education research (Teo et al., 2014), which became one rationale for this research. This fact needs to be regarded with respect to the cited reviews' relatively older (in this respect) date, as this rapidly emerging field has been penetrating science education research as much as any other field. Nevertheless, the number of studies focusing on concrete examples of technology's use exceeds the number of more abstract, generally focused studies, which would provide comprehensive evidence of technology's effect in education. The latest or highly cited studies focusing on concrete educational technology in science education deal e.g., with augmented reality (Arici et al., 2019; Chang et al., 2018; Lai et al., 2019; Sahin & Yilmaz, 2020), mobile learning (Crompton et al., 2016; Tavares et al., 2021; Zydney & Warner, 2016), online/web-based/internet-based learning (Al Mamun et al., 2020; Lee et al., 2011; Yang et al., 2015) and computer simulations (Develaki, 2019; Repenning et al., 2015; Smetana & Bell, 2012). Chemistry education researchers (Alkan & Koçak, 2015; Corradi et al., 2012; Correia et al., 2019) deal mostly with multimedia and engaging technology in teaching and teacher training. This is more concrete than the focus of this research, which sought for a more unified view of the phenomena. According to Venkatesh et al. (2003), technology must be accepted and used, because without it productivity cannot be improved. This naturally also applies to education. There have been several attempts to describe (science) secondary school teachers' behaviour with respect to technology use in general (Badia & Iglesias, 2019; Higgins & Spitulnik, 2008; Rusek et al., 2017; Walan, 2020) and specific technology, e.g., mobile devices (Ates & Garzon, 2021; Chiu & Churchill, 2016; Leem & Sung, 2019; Mutambara & Bayaga, 2021), interactive whiteboards (Stroud et al., 2014; Šumak et al., 2017; Tosuntas et al., 2021) or virtual laboratories (Achuthan et al., 2020; Spernjak & Sorgo, 2009), and simulations (Bo et al., 2018; Kriek & Stols, 2010; Lee et al., 2021), however they focused on this process from a more general perspective.

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Educational Software (EduSW)

For this research's purpose, EduSW was defined as a learning tool predetermined for teaching and self-learning by using educational technology with learning as the end product (Januszewski & Molenda, 2013, p. 15). EduSW is a computer application developed for the purpose of teaching and learning. Chemistry EduSW includes experiment simulations, virtual or mobile labs, various applets showing scientific/chemical phenomena, etc. (see da Silva Júnior et al., 2014; Kupatadze, 2013; Marson & Torres, 2011; Romero et al., 2020). EduSW has the potential to promote scientific conceptions (Bell & Trundle, 2008) as well as their learning gains (Scalise et al., 2011). Some authors (Marson & Torres, 2011; Solomonidou & Stavridou, 2001) argued EduSW can demonstrate more levels in a chemistry experiment at once, which facilitate learners' understanding of the chemical process and scientific concepts and in the case of virtual labs, it can also improve learners' laboratory work (Ramadhan & Irwanto, 2017). Using EduSW in teaching also has other advantages, such as the promotion of teaching clarity, individualization of teaching, management of a learner's step-by-step learning, higher stimulation of learners and increased teaching interactivity (Fialho & Matos, 2010; Stoica et al., 2010). EduSW was also found to reduce a prior-knowledge achievement gap in a guided learning chemistry class (Lou & Jaeggi, 2020).

Theories of Innovation/Technology/Software Acceptance

This research was focused on teachers' use of EduSW. It is, logically, used on electronic devices, therefore, technology use is automatic. From the history of pedagogy's point of view, technology still represents an innovation in a general sense. For this reason, there are two models/theories which backed this research.

Rogers' theory of Diffusion of innovations from 1962 can be applied as there is still a parallel between innovation and technology (Rogers, 2003). It was designed to explain how, when, why, and how quickly new ideas and technology spread. Rogers (2003, p. 27) dealt with „the degree to which an individual is able to influence other individuals' attitudes or overt behaviour informally in a desired way with relative frequency" using the term *opinion leaders*. Rogers (2003) further specified the characteristics of such agents in society, defining both opinion leaders and leaders who oppose change, and proposed a model to introduce innovation into a system once its elements are known.

More than four decades later, Venkatesh et al. (2003) put forward Unified theory of acceptance and use of technology (UTAUT), building on several theories and using Rogers' original idea of technology being an innovation. It was built on a combination of eight previous theories on the acceptance and motivation to use technology: theory of reasoned action, technology acceptance model, motivational model, theory of planned behaviour, combined theory of planned behaviour/technology acceptance model, model of personal computer use, diffusion of innovations theory and social cognitive theory. To create a unified theory, UTAUT defines four fundamental determinants of behavioural intention (BI) for the use of a given technology (USE). The following concepts are included:

- *Performance Expectancy* (PE) – the belief that using technology (innovation/software/system) will help the user to achieve improved performance (Chroustová et al., 2017; Šumak & Šorgo, 2016; Venkatesh et al., 2003),
- *Effort Expectancy* (EE) – the degree of simplicity associated with the use of technology (Chroustová et al., 2017; Venkatesh et al., 2003),
- *Social Influence* (SI) – the degree of conviction that people who are important to users (family, friends or colleagues, learners, their parents, management, etc.) believe that they should use this technology (Chroustová et al., 2017; Rogers, 2003; Venkatesh et al., 2003) and
- *Facilitating Conditions* (FC) – the degree users believe there is an organizational and technical infrastructure to support the use of technology (Chroustová et al., 2017; Venkatesh et al., 2003).

In the original UTAUT model, the effects of moderators: gender, age, experience, and voluntariness of use was stressed (Venkatesh et al., 2003). According to Dwivedi et al. (2019), moderators may not be universally applicable to all contexts. Gil-Flores et al.'s (2017) research showed that gender, age, and teaching experience are irrelevant to ICT use. Consistent with these results and with respect to the contemporarily growing notion that gender is not a binary variable (understandably omitted in all the cited studies), gender, age, and experience's influence on the use of EduSW in teaching was not considered. Based on this and the fact that the use of EduSW is not obligatory in Czechia, moderators from the original UTAUT were omitted.

Both cited models (Rogers, 2003; Venkatesh et al., 2003) originally deal with technology in general, yet are further being applied more concretely in specific fields (Bennett & Bennett, 2003; Khechine et al., 2020; Ogrezeanu

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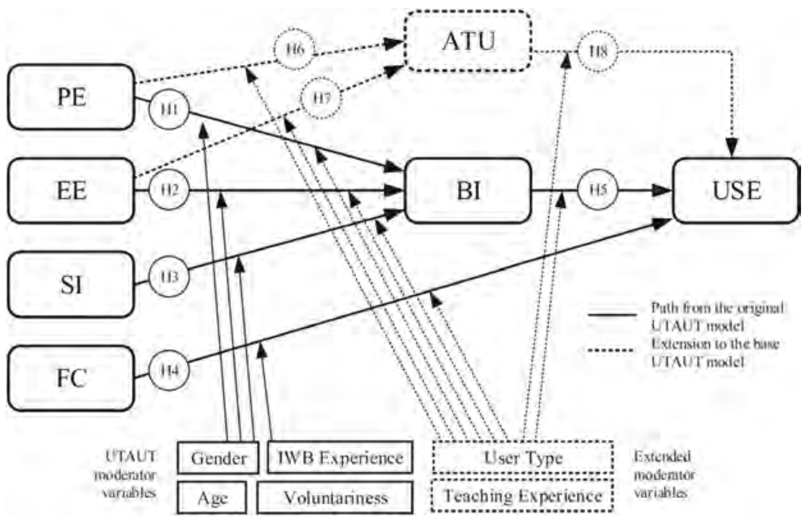
& Ogrezeanu, 2014; Rusek et al., 2017; Seymour, 2002; Zounek & Sebera, 2005). Venkatesh's original model was recently revisited by Šumak and Šorgo (2016), who extended the model by adding several constructs (see Figure 1).

Figure 1

Extended UTAUT Model for Acceptance and Use of Interactive Whiteboards among Teachers (Šumak & Šorgo, 2016)



Note. PE = Performance Expectancy; EE = Effort Expectancy; SI = Social Influence; FC = Facilitating Conditions; ATU = Attitude Towards Using; BI = Behavioural Intention; USE = Use

The first, called *Attitude towards Using Technology* (ATU) as a user's overall affective reaction to using technology, in this research to using EduSW in chemistry education includes favourable or unavoidable feelings towards this behaviour (Ajzen, 1991; Chroustová et al., 2017). In an attempt to evaluate as complex a model as possible, the theory of reasoned action (Fishbein & Ajzen, 1977) and technology acceptance model (Davis et al., 1989) were also revisited in this research. They were considered in the original UTAUT, however, the ATU's influence on BI was not evaluated. For this reason, this hypothesized path was also added to our proposed model.

Another two added constructs were considered to affect BI: *Motivation* (M), according to the motivational model (Wilson & Lankton, 2004) and *Personal Innovativeness in IT* (PIIT), seen as a teacher's willingness to try out and implement new forms of ICT in their lessons (Agarwal & Prasad, 1998; Lu et al., 2005). This was also a strong predictor of BI to use EduSW and the current use of ICT applications in chemistry education (see Ertmer, 2005).

As the extended version of the UTAUT model is supposed to cover the acceptance and use of EduSW in education specifically, the *Perceived Pedagogical Impact* (PPI) represents a decisive factor that affects teachers' ATU regarding EduSW use in education, as well as BI and USE constructs (Šumak et al., 2017). PPI is seen as teacher's belief that using EduSW in chemistry education will have an impact on chemistry education. In research regarding the adoption of interactive whiteboards (Šumak et al., 2017) were proved both PE and EE influence ATU, and ATU influences USE.

Research Methodology

General Background

Structural Equation Modelling (SEM) was chosen to test the proposed model of acceptance and use of EduSW by chemistry teachers (see Figure 2), as well as to verify the formulated hypotheses (cf. Byrne, 2016). SEM integrates factor analysis, multiple regression, and sectional analysis into one method and is a more appropriate method for the confirmatory access and exploration of complex dependencies between variables (Kline, 2015).

Additionally, there are different groups of teachers who approach technology (innovations) differently and can be worked with accordingly (Rusek et al., 2017). In this research, models for each user type group separately were also tested.

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Research Model and Hypotheses

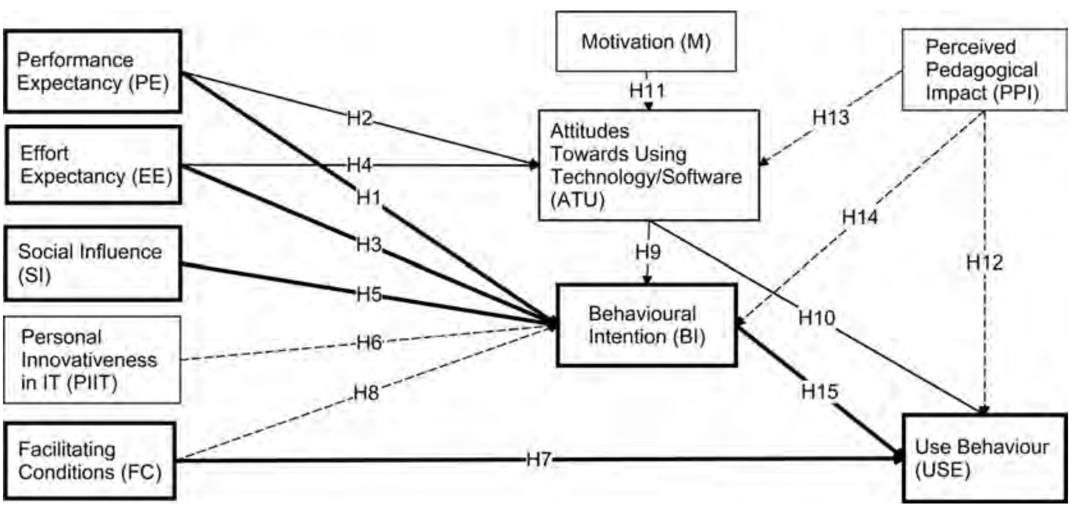
The original models (Rogers, 2003; Venkatesh et al, 2003) assessing the use of technology were updated and modified to evaluate the use of interactive whiteboards (Šumak & Šorgo, 2016). By focusing on EduSW, the research model, naturally, needs to be modified to serve its purpose too (statements for measuring the model construct are in Appendix 1). Bold continuous lines in Figure 2 emphasize the original UTAUT constructs (Venkatesh et al., 2003) and hypothesized paths (H1, H3, H5, H7, H15). Standard continuous lines frame the newly added constructs and hypothesized paths (H2, H4, H10) implemented according to the research concerning interactive whiteboard adoption (Šumak & Šorgo, 2016). The dashed lines represent hypothesized paths between the newly added (and tested) constructs, including those used in previous models:

- H6 was added according to Agarwal and Prasad (1998) and Ertmer (2005),
- H8 was added according to Sultana (2020),
- H9 was added according to Fishbein and Ajzen (1977) and Davis et al. (1989),
- H11 was added according to Wilson and Lankton (2004) and
- H12, H13, H14 were added according to Šumak et al. (2017).

The hypotheses shown in Figure 2 and Figure 3 were set to parts of the tested model as follows: "*the construct at the beginning of the arrow* has a significant effect on *the construct at the end of the arrow* in chemistry education". Therefore, for example:

H_1: *Performance Expectancy* has a significant effect on *Behavioural Intention* to use EduSW in chemistry education.

Figure 2
Research Model of EduSW's Acceptance and Use in Chemistry Education



With respect to Rogers' (2003) theory, as well as known differences between EduSW users and nonusers considered in the previous research (Chroustová et al., 2017), the following teacher groups were distinguished based on their answer to the question if they use(d) EduSW. The teachers identified as *current users* answered "Yes", *former users* had used EduSW and abandoned it, *non-planning nonusers* do not use EduSW and have no intention to do so in the future and *planning nonusers* do not use EduSW but are planning to do so in the future (Šumak et al., 2017; Šumak & Šorgo, 2016).

Chroustová et al.'s (2017) results confirmed not only differences between *current users* and groups of *nonusers*, but also showed differences within the nonusers. Based on these results, a new approach to the model's application was chosen. The model for the acceptance and use of EduSW in chemistry education was therefore examined for each group separately. An analysis of independent models for each user type group would enable determination of the factors which affect teachers' acceptance and use of EduSW in chemistry education based on their user type. This would help identify ways to encourage teachers to use EduSW in education. By focusing on individual groups of teachers / technology users, the intervention is more likely to be effective (cf. e.g., Rogers, 2003).

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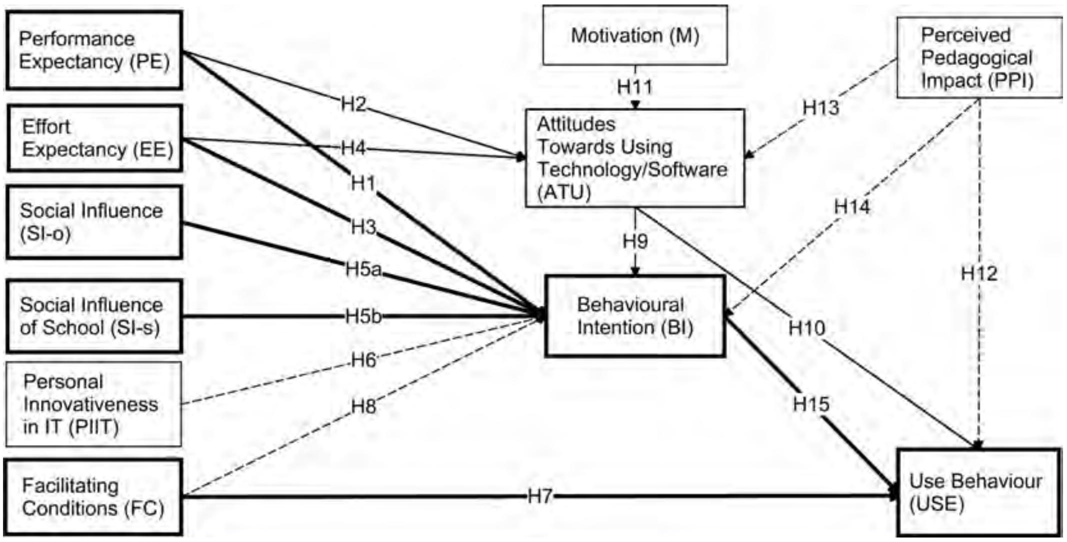
After data collection, the proposed research model (see Figure 2) was examined by principal component analysis. Its results (see Appendix 2) showed social influence disintegration: the social influence of school management and climate (SI-s) was separated from the overall social influence (further SI-o, see Figure 3). The corresponding hypothesis was therefore divided into two.

Figure 3

Modified Research Model of EduSW's Acceptance and Use in Chemistry Education



Sample

The appropriate sample size in this type of research is more than 200 participants, according to the rule of thumb (Kline, 2011). A purposive sample (Teddlie & Yu, 2007) was used because random sampling was infeasible as it was impossible to address a selected teacher directly. Teachers from schools included in the research were selected using the Register of Schools from the Ministry of Education, Youth and Sports (MŠMT, 2019). If possible, teachers were addressed directly (2,549 teachers) or through the school headmasters or deputies from 2,266 lower-secondary and 423 upper-secondary schools (including grammar and vocational /technical/ school). First, each addressee received an e-mail with a request to complete the questionnaire via an online 1KA application. If no response came, a request reminder was sent after ten days. The completion of the questionnaire was voluntary and anonymous, no data were collected that would allow the identification of the respondents. The data collection was stopped after receiving more than 550 complete responses (approximately 8.5% of the chemistry teacher population in the Czech Republic). The questionnaire was completed in its entirety by 564 teachers, however, 8 non-valid responses had to be excluded. Overall, 556 complete questionnaires were analysed.

The sample represents teachers ($N = 556$) from mostly lower-secondary (65.8%) and general upper secondary (grammar) schools (23.6%). Teachers are also divided by user type into current users – UT1 ($N = 183$), former user – UT2 ($N = 23$), non-planning nonusers – UT3 ($N = 138$) and planning nonusers – UT4 ($N = 212$).

A typical respondent in the research is a female teacher (83.2%) aged between 35 and 44 years (31.0%) or older (51.2%), with teaching qualifications (95.7%) and between 6 and 25 years of teaching experience (59.2%), who usually did not have the opportunity to become familiar with EduSW (38.8%) during their studies and has not used EduSW recently (62.9%).

Instrument and Procedures

With respect to previous research in this field (e.g., Davis et al., 1989; Rusek et al., 2017; Šumak & Šorgo, 2016), a questionnaire was used. The questionnaire's development and validation were described by Chroustová et al. (2017) in more detail, it is therefore introduced only briefly. The questionnaire items were divided into three categories:

Demographic statements such as gender, age, working status, length of teaching experience, workplace, qualifications, and experience with EduSW,

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Statement to measure the model construct (see Appendix 1), adjusted for acceptance and use of EduSW, i.e., items taken mainly from the UTAUT (Venkatesh et al., 2003) and other studies focused on technology acceptance (see Table 1),

Additional questions which more precisely described teachers' experience with EduSW and its use or reasons why it was abandoned.

The number of questions was dependent on respondents' answers about their experience with the use of EduSW. To measure the statements, a 7-point Likert scale with defined extremes from "strongly disagree" (1) to "strongly agree" (7) was used (see Finstad's (2010) recommendation). For this reason, the data were treated as ordinal (see Chytrý & Kroufek, 2017).

Cronbach's alpha for each of the constructs in the model for all teachers was calculated to range from .74 to .98 (see Appendix 3), which points to the tool's satisfactory reliability (Tavakol & Dennick, 2011). For individual user types (current users – UT1, former user – UT2, non-planning nonusers – UT3 and planning nonusers – UT4), it was a little lower, i.e., from .64 to .95, which is still acceptable (Field, 2013).

Table 1
Constructs Used in the Models

Construct	Abbreviation	Items	References
Performance Expectancy	PE	PE1, PE2, PE3	(Chroustová et al., 2017; Šumak & Šorgo, 2016; Venkatesh et al., 2003)
Effort Expectancy	EE	EE1, EE2, EE3(R)	(Chroustová et al., 2017; Šumak & Šorgo, 2016; Venkatesh et al., 2003)
Facilitating Conditions	FC	FC1, FC2, FC3	(Chroustová et al., 2017; Šumak & Šorgo, 2016; Venkatesh et al., 2003)
Social Influence	SI-o	SC1, SC2, SC3, SC4, SC7, SC8	(Chroustová et al., 2017; Šumak et al., 2017; Šumak & Šorgo, 2016; Venkatesh et al., 2003)
Social Influence of School	SI-s	SC5, SC6,	(Chroustová et al., 2017) – originally part of the construct above
Attitude Towards Using	ATU	ATU1(R), ATU2, ATU3, ATU4, ATU5(R), ATU6(R)	(Chroustová et al., 2017; Šumak & Šorgo, 2016; Venkatesh et al., 2003)
Behavioural Intention	BI	BI1, BI2, BI3	(Chroustová et al., 2017; Šumak & Šorgo, 2016; Venkatesh et al., 2003)
Use	USE	USE1, USE2, USE3	(Chroustová et al., 2017; Šumak & Šorgo, 2016)
Personal Innovativeness in IT	PIIT	PIIT1, PIIT2, PIIT3, PIIT4 (R)	(Chroustová et al., 2017; Lu et al., 2005; Šumak et al., 2017)
Motivation	M	M1, M2, M3, M4, M5	(Guay et al., 2000; Chroustová et al., 2017)
Perceived Pedagogical Impact	PPI	PPI1, PPI2, PPI3, PPI4, PPI5, PPI6, PPI7, PPI8	(Chroustová et al., 2017; Šumak et al., 2017)

Data Analysis

First, the data were transferred to an MS Excel file and checked. Next, they were transferred to the IBM SPSS 24 for descriptive analyses (Field, 2013). Due to the non-normal distribution of some answers, nonparametric statistics (Mann-Whitney *U* test asymptotic *Z*-score) was chosen to assess the differences in answers between types of users (see Chroustová et al., 2017). AMOS 24.0 was used to statistically process the models. Before applying SEM, principal component analysis with direct Oblimin rotation was accomplished (see Appendix 2) as a tool to explore the unidimensionality of the constructs (Field, 2013; Kline, 2015).

Considering the differences between user types (see Chroustová et al., 2017), the model for the acceptance and use of EduSW in chemistry education for each group was examined (current users, former user, non-planning nonusers and planning nonusers) separately.

The model development process was similar to a single model for all teachers. The initial measurement models were constructed in AMOS with respect to the results from the principal component analysis for all users

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together, and for each of the four user types separately. The predicted factors were modelled as latent variables and co-variances were drawn among them.

The goodness-of-fit indices are indicators of a valid model (Schreiber et al., 2006). In this research, chi-square (χ2), degrees of freedom (*df*), normed chi-square (χ2/*df*), comparative fix index (CFI), root mean square error approximation (RMSEA), normed fix index (NFI) and parsimony normed fit index (PNFI) are reported. The model has been further evaluated for validity and reliability using metrics for internal consistency, composite reliability (CR, Cronbach's alpha), convergent validity (average variance extracted – AVE), and discriminant validity (AVE, Maximum Shared Variance – MSV and average shared Variance – ASV). Convergent validity monitors whether a given item actually measures one construct, while discriminant validity verifies the mutual distinction of individual constructs (Kline, 2015). To confirm convergent validity, CR should reach values greater than .7 and Average Variance Extracted (AVE) higher than .5 (Šumak et al., 2017). We validate discriminant validity if AVE is greater than MSV or ASV and if the root AVE is larger than the correlation *r* with other constructs (Šumak et al., 2017): $AVE > MSV \vee AVE > AVS \wedge \sqrt{AVE} > r$.

In the model, the hypothesized effects among variables are shown as standardized regression ß along with their *p*-value (with standard α = .05) based on Suhr's recommendations (2006). According to Cohen (1988), the influence rate is evaluated in the same way as effect size. It was evaluated as follows: small effect .10 – < .30, medium effect .30 – < .50, large effect ≥ .50 (Cohen, 1988). Furthermore, in the model, coefficients of determination R^2 are depicted, representing part of the overall variance possible to explain through the model (Kline, 2011). This implies the accuracy of the newly proposed model's prediction.

Research Results

Analysis Results of Measurement Models

Given the complexity of the research models, some shortcomings in discriminatory validity and the goodness-of-fit indices (see Table 2) were expected. It was therefore necessary to modify the models further according to recommendations from AMOS. Several items were removed from the constructs based on the Cronbach's alpha value, "if removed" or based on a low factor load. The final list of items used, together with factor loadings, is provided in Appendix 4. Some of the final models show a slightly lower convergent validity (see Appendix 5). This concerns the construct FC in the model for all users (.49), UT3 (.45), UT4 (.43) and M in the model for UT4 (.49). Nevertheless, in these cases the AVE is higher than .4 and composite reliability is higher than .6, so according to Fornell and Larcker (1981), the convergent validity of the construct is still considered adequate. A similar situation concerns the discriminant validity: FC (in the model for all users, UT3 and UT4), PPI (in the model for UT1) and M (in the model for UT1, UT4) lack discriminant validity (AVE values are greater to ASV but less than MSV), which can show possible non-independence of those factors.

Table 2
The Goodness-of-Fit Indices for Models with Recommended Level

	All user Type		User type 1		User type 3		User type 4	
	Initial model	Final model	Initial model	Final model	Initial model	Final model	Initial model	Final model
χ^2	3807	2740	2058	1283	2069	1683	2127	1155
df	952	696	952	621	952	893	952	558
χ^2/df < 3.00	4.00	3.94	2.16	2.07	2.17	1.89	2.23	2.07
CFI > .90	.87	.90	.83	.88	.78	.84	.83	.89
RMSEA < .08	.07	.07	.08	.08	.09	.08	.08	.07
NFI > .80	.84	.87	.72	.79	.66	.72	.73	.81
PNFI > .60	.77	.77	.66	.70	.61	.65	.67	.72

Note. χ^2 chi-square, *df* degrees of freedom, χ^2/*df* normed chi-square, CFI comparative fix index, RMSEA root mean square error approximation, NFI normed fix index, PNFI parsimony normed fit index

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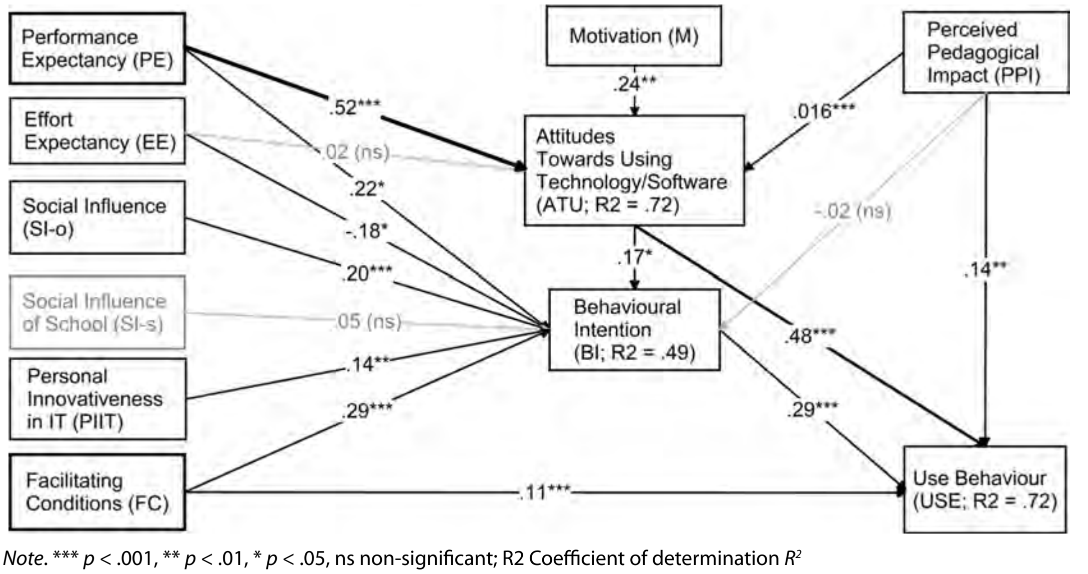
Factors Influencing the Acceptance and Use of EduSW (RQ1, RQ2)

After the modification, we focused on testing the hypotheses. The models are presented by figures followed by comments. In Figure 4, the model for all user types is presented, followed by the model for UT1 (current users) in Figure 5. The model for UT2 (former users) was not provided because of an insufficient number of responses. Figure 6 shows the model for UT3 (non-planning nonusers) and Figure 7 the model for UT4 (planning nonusers).

Figure 4
The Results of Hypothesis Testing for All Teachers (With Standardized Beta Coefficients)



Note. *** $p < .001$, ** $p < .01$, * $p < .05$, ns non-significant; R2 Coefficient of determination R^2

When chemistry teachers were considered *a united group*, the results showed that BI was influenced by all the expected constructs (albeit in a modified form) in accordance with the original UTAUT theory. FC (ß = .29, $p < .001$), PE (ß = .22, $p < .05$), SIa (ß = .20, $p < .001$), ATU (ß = .17, $p < .05$), and PIIT (ß = .14, $p < .01$) positively affect teachers' BI regarding the USE of EduSW, whereas EE (ß = -.18, $p < .01$) was found to affect BI negatively. From the mentioned factors, FC has the strongest positive effect on BI. There was no significant relationship between SI-s and BI and PPI and BI. ATU is significantly affected by PE (ß = .52, $p < .001$), M (ß = .24, $p < .001$) and PPI (ß = .16, $p < .01$). The use of ES can be directly and positively influenced by expected BI (ß = .29, $p < .001$), PPI (ß = .14, $p < .01$) and FC (ß = .11, $p < .01$), but ATU (ß = .48, $p < .001$) has the strongest influence.

Features of Particular EduSW User Groups (RQ3)

The results also showed several strong relations within particular EduSW user groups. These results have the potential to influence the design of "made to measure" courses for particular EduSW users (teachers).

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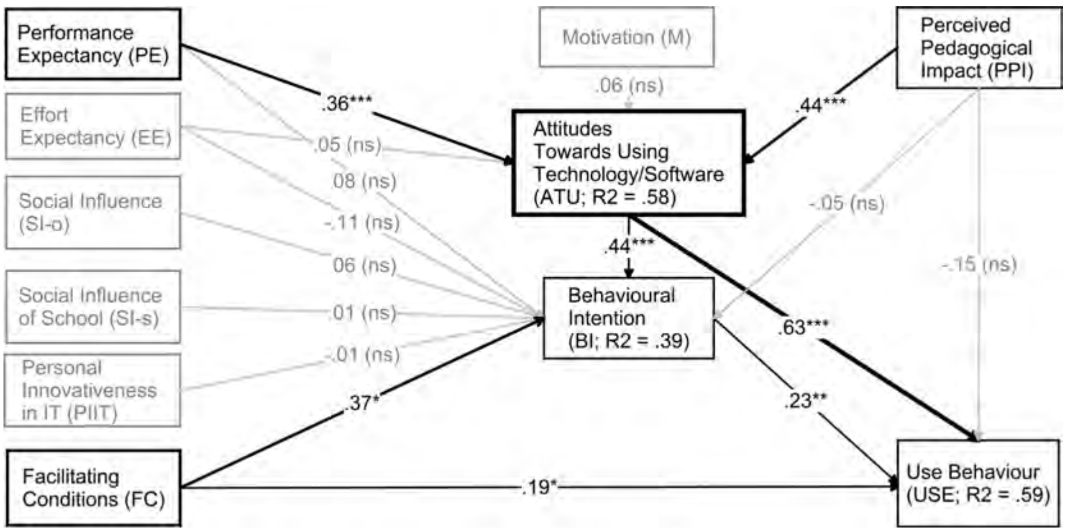
Figure 5
The Results of Hypothesis Testing for Current Users (With Standardized Beta Coefficients)

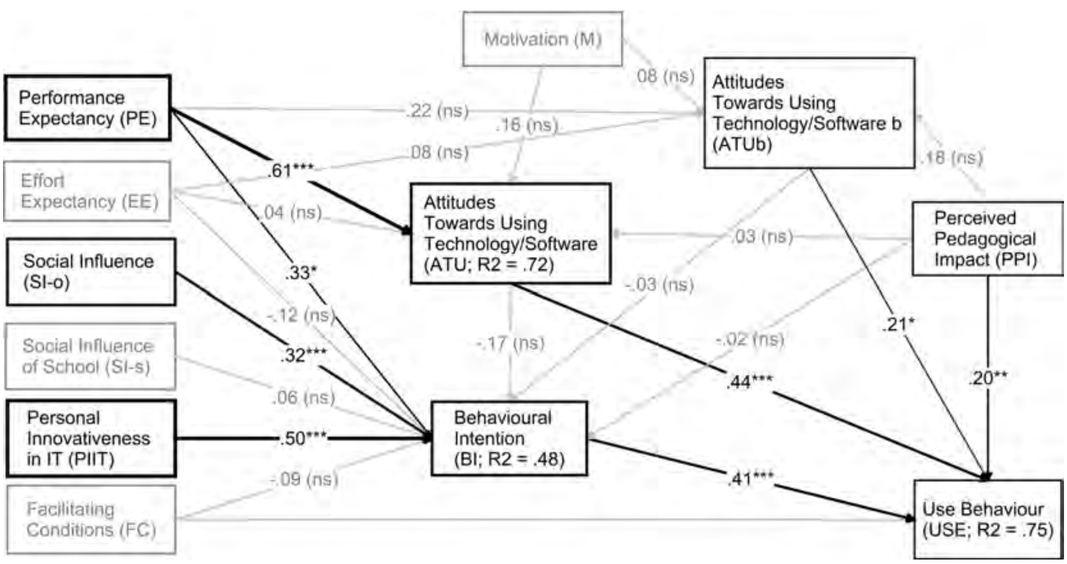


Note. *** $p < .001$, ** $p < .01$, * $p < .05$, ns non-significant; R2 Coefficient of determination R^2

In the case of *current users*, the final model, showed PE's influence on ATU (ß = .36, $p < .001$) in a similar way to the entire teacher group, although to a lower degree, and also ATU's strong, direct influence on USE (ß = .63, $p < .001$). On the contrary, ATU was found to have a stronger effect on this group of teachers than the model for all teachers.

Another similarity with the tested model for all teachers was in the medium effect of FC on BI (ß = .37, $p < .05$) and the small effect on USE (ß = .19, $p < .05$). Also, BI's effect size on USE (ß = .26, $p < .01$) was approximately equal in both models. The effects of EE, SI-o, Si-s, and PIIT on BI are non-significant.

Figure 6
The Results of Hypothesis Testing for Non-Planning Nonusers (With Standardized Beta Coefficients)



Note. *** $p < .001$, ** $p < .01$, * $p < .05$, ns non-significant; R2 Coefficient of determination R^2

The model for *non-planning nonusers* showed PE has a very strong and significant influence on ATU (ß = .61, $p < .001$), which also directly affects USE. In this model, there are several factors significantly influencing BI: PIIT (ß = .50, $p < .001$), followed by PE (ß = .33, $p < .05$) and SI-o (ß = .32, $p < .001$).

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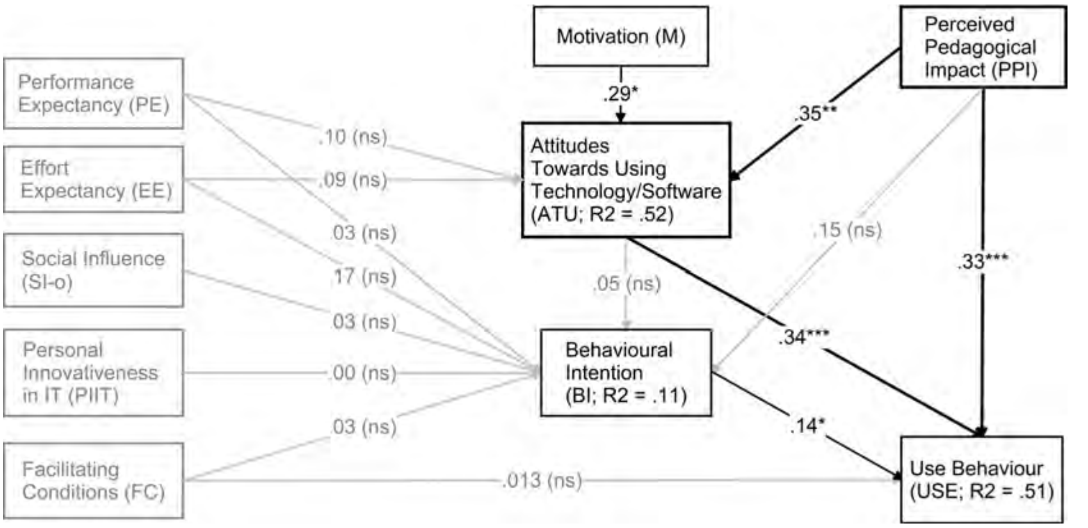
In addition, ATU (ß = .44, $p < .001$) and BI's (ß = .41, $p < .001$) influence on USE is on a comparable level in this model. PPI's impact on USE (ß = .20, $p < 0.01$) is also similar to the single model for all teachers. The ATUb construct (created based on principal component analysis by separating two items focusing on whether it is a good idea to use the software or whether it has added value) has a lesser impact on USE than ATU (i.e., ß = .21, $p < .05$), which shows areas that can be targeted centrally to all teachers and, vice versa, shows which factors are treated more effectively if a certain group is addressed.

Figure 7

The Results of Hypothesis Testing for Planning Nonusers (With Standardized Beta Coefficients)



Note. *** $p < .001$, ** $p < .01$, * $p < .05$, ns non-significant; R2 Coefficient of determination R^2

In the model for *planning nonusers*, ATU (ß = .34, $p < .001$) and PPI (ß = .33, $p < .001$) were proven to have an influence on the USE of EduSW. The extent was almost the same as in the previous model. PPI's significant influence on ATU (ß = .35, $p < .01$) is consistent with the current users' model. Interestingly, in this model, ATU is also significantly influenced by teachers' motivation (M; ß = .29, $p < .05$), unlike in previous models where this role was held by PE. The BI's influence on USE is the smallest from all tested models (ß = .14, $p < .05$), showing BI was not significantly influenced by any construct.

Comparing the Models for Particular Groups

By comparing the above presented models for particular groups of EduSW (non)users, ATU's medium to large effect sizes on USE in all models was found. Also, PPI's influence on USE was of a similar size, albeit to varying degrees, as was BI's influence on USE. ATU's influence on USE was found even stronger than BI's (i.e., ATU plays a more important role than BI in models of acceptance and EduSW use). For this reason, encouraging chemistry teachers to use EduSW by strengthening a positive attitude towards using EduSW in chemistry education (i.e., the teacher's belief that chemistry education is more interesting, fun, and enjoyable with EduSW) needs to be focused on. The findings suggest it can be done by focusing either on:

- PE (i.e., the belief that EduSW is useful for teaching, which makes it possible to achieve learning objectives faster or increases teaching effectiveness) for current users and non-planning nonusers,
- M (i.e., personal reasons for including EduSW, perceiving EduSW use as an interesting activity) for planning nonusers or
- PPI (i.e., influence of EduSW's inclusion on students' curiosity, concentration, creativity, motivation, learning outcomes, etc.) for current users and planning nonusers.

Although BI is not as strong a factor as ATU, its influence on the use of EduSW by teachers was also proven, so BI support can lead to more frequent use of EduSW. However, each group (with the exception of planning nonusers – no factor effect was found on BI) requires a different type of intervention, or in other words, teachers from

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different groups are more likely to want to use EduSW under different treatment:

- FC (includes the knowledge and resources necessary to use EduSW or the possibility of support in case of difficulties with EduSW) for current users,
- SI-o (i.e., the belief that people important to them, influencing their behaviour, the public, other teachers, or parents of learners think they should use EduSW) and PIIT (i.e., the degree of willingness to test and integrate new information technology) for non-planning nonusers.

Discussion

The results of the research are showing strength and consequently a role of factors affecting teachers' acceptance and use of EduSW in chemistry teaching following the use of SEM analysis. As no other research focused on teachers' use of EduSW has been published, other educational technologies are used to discuss the results.

To compare, in the case of teachers' SmartBoard acceptance, Raman et al. (2014) reached almost the same values for FC's positive significant effect on BI. The strongest influence was, nevertheless, reported for PE in Raman et al's (2014) research. On the other hand, in the model for *teachers as united group* tested in this research, EE's effect on BI was found to be negative, which suggests that the easier it is for teachers to acquire skills and work with EduSW, the less they tend to use it. Here, the difference between using any software and using an interactive board as hardware may differ, despite interactive boards' major contribution being in the programs/applets they use. These results can then be caused by, e.g., an unsatisfactory level in the used software's interactivity, or a preference for their own interactive educational materials. The explanation for this trend may lie in the teachers' perception of EduSW – typically of an official nature, designed for educational purposes. Nevertheless, as pointed out by Ertmer et al. (2012), thanks to low-cost Internet access devices and easy-to-use digital authoring tools (e.g., Lectora, Elucidat, LearningApps, Wizer.me, etc.), teachers no longer need to purchase (expensive) EduSW to provide their students with digital content. Also, there are many teachers' groups online who share their materials on daily basis. Adopting these seems far easier than creating their own in the software.

In contrast to the original UTAUT, ATU, not BI, was found to be the most important and strongest factor directly affecting the USE of EduSW in model for all teachers. The results showed ATU is most strongly influenced by PE. The addition of this factor was proven to fit, similar to Šumak and Šorgo's (2016) results on teachers' use of interactive whiteboards, where ATU was proven to be strongly influenced (not only) by PE (with a greater effect size for pre-adopters) and had a direct effect on USE. In addition, ATU's significant role in ICT usage in teaching was confirmed in other research (Ertmer et al., 2012; Gil-Flores et al., 2017; González-Sanmamed et al., 2017). Moreover, Chatterjee and Bhattacharjee (2020), who placed ATU between PE, EE, PR (perceived risk) and BI without a direct influence on USE in their model, also confirmed its great influence. The effect of PE on ATU was, however, insignificant.

PE is also considered a primary attitude factor for secondary school teachers' acceptance of a digital learning environment (Pynoo et al., 2011). It seems that in order to support the use of EduSW in teaching, it is necessary to improve teachers' attitudes to this technology, which can be achieved by providing evidence of a real positive effect on teaching performance, such as software efficiency research (e.g., Kunduz & Secken, 2013; Tatli & Ayas, 2013), seminars with examples of good practice, success stories, etc. (González-Sanmamed et al., 2017).

In the case of *current users'* final model, the difference in the role of PPI as the strongest effector on ATU in comparison to entire teacher group model was found. This finding corresponds with Šumak et al. (2017), who considered PPI a factor influencing EE and PE and confirmed its positive effects on PE. The results also indicate that teachers who already use EduSW do not need encouragement by social influence or support for their skills in IT (cf. Rusek et al., 2017). To prevent their transition to the former user group, it seems access to EduSW (and necessary technology for using) with a real impact on teaching and students (e.g., their curiosity, creativity, concentration, motivation, and achievement) needs to be provided.

The model for *non-planning nonusers* showed PIIT as the strongest factor affecting BI. As far as PIIT is concerned, Nov and Ye (2008) reported it is negatively influenced by Resistance to Change and positively by Openness (a person's receptivity to new ideas and experiences). Teachers characterized with lesser PIIT can be supported by early EduSW adopters (cf. Rogers, 2003) who share their experiences and opinions with other teachers and help them to use the technology, which facilitates its subsequent diffusion into teaching (Jackson et al., 2013; Rusek et al., 2017). Those results showed PIIT and SI-o's joint role in teachers´ EduSW use intentions.

It is logical that promoting the use of EduSW is more demanding among non-using teachers than EduSW users. The findings showed that to promote use of EduSW by non-using teachers, an environment where users

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share their knowledge, skills and experience among nonusers needs to be created. Also, a platform for learning materials' distribution or promotion seems to support the process. Moreover, teachers' attitudes to EduSW can be improved by providing examples of good practice and evidence of its influence on both teaching performance and pedagogical impact. Last but not least, this effect is amplified when these examples are shown by colleagues (early adopters) or experienced technology users (Rogers, 2003; Rusek et al., 2017).

In the model for *planning nonusers*, the results showed that BI's influence on USE was the smallest from all tested models. This is probably because the teachers in this group already intend to use EduSW, so no other reason to increase their intention is needed. However, BI's small effect on USE can be explained by them staying in the intention phase without ever using EduSW after all. When the role of intrinsic motivation while taking their feelings about using EduSW into consideration, another way to interpret these results can be the teachers' anxiety to use EduSW or technology in general (Celik & Yesilyurt, 2013). Agyei and Voogt's (2011) results of Ghanaian teachers support this conclusion – their attitudes, competency in handling technology and access to it were proven to be essential factors of integrating technology in teaching practice. Naturally, the goal is to move teachers who plan to use technology (i.e., are not opposed to it) from the mere intention towards its use.

Research Limitations

The limitations of this research lie in the inability to guarantee the same opportunity for every teacher to participate in the research. In spite of the effort put into sample selection, not every chemistry teacher in Czechia's contact addresses were available. Also, teachers participated voluntarily, which naturally leads to generally passive teachers – probably IT-objectors – being eliminated from the research sample. Moreover, the data need to be evaluated with discretion as the results represent teachers' standpoints expressed towards statements in a questionnaire. Triangulation by observing their lessons would provide more information. Naturally, this was impossible to perform within one research period.

Conclusions and Implications

The aim of the research was to analyse the factors influencing chemistry teachers' acceptance and use of EduSW in chemistry education with respect to differences between teachers according to their user type, as well as to illustrate the factors which intervene in this process in each user type group. For this purpose, a new – extended – UTAUT model was used. The original UTAUT model was completed based on the theories and results of several studies focused on the acceptance and use of educational technology (software).

From the many factors influencing teachers' acceptance and use of EduSW, attitudes towards use, performance expectancy (teachers' belief that the use of EduSW will contribute to their teaching performance), facilitating conditions (teachers' belief that they have sufficient conditions for the use of EduSW in chemistry education) and perceived pedagogical impact (teachers' belief that the use of EduSW will have a pedagogical impact on chemistry education as far as the effect is concerned) proved to be the strongest factors. In case of the individual groups' models, the behavioural intention of current EduSW users is most influenced by facilitating conditions. Teachers need background and support not only on a material level, but also the possibilities of sharing good practice in EduSW use. The non-planning users' behavioural intention is the most strongly affected by their personal innovativeness in IT. For this reason, training these teachers in digital literacy focusing on EduSW and inspiration could help change their intention not to use EduSW. Teachers already planning to use EduSW's behavioural intention seem not to be influenced by any of the proposed factors. For all models, attitudes towards the use of EduSW play a key role because they influence the use of EduSW more strongly than even behavioural intention and this is therefore potentially the area to focus on first.

This research provided a vital rationale for both pre- and in-service teacher training courses focused on this area. It seems reasonable to offer IT-related (EduSW-focused) courses to preselected groups of teachers according to their user type, with the above-mentioned characteristics included and carefully crafted so the course brings as much effect to the participants as possible. In-service training courses, typically taught by university teachers could benefit from including lectors from school practice as they were shown to gain teachers' trust by affecting their intention to use EduSW "because what is working well for them could work well for me".

Further research should focus on identifying a larger group of former EduSW users and creating a model of EduSW's acceptance and use for this group, as well as examining the reasons why this group rejected EduSW in more detail. This can later be linked with the reasons identified in this research through other groups of nonusers to

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check whether new unexpected motives appear. The research could be extended by observing teachers and their work with EduSW in chemistry lessons. Also, extending the sample to teachers in other countries would provide results with more international validity. One of the next steps in the research could also focus on the learners' views on the acceptance and use of EduSW.

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Declaration of Interest

The authors declare no competing interest.

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Appendix 1

Table A1.1
Measurement Items and Scales for Current Users (UT1) and Former Users (UT2) (Chroustová et al., 2017)

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.
EE3a	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
ATU1a	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.
ATU5a	Educational software should by only supplement of chemistry teaching.
ATU6a	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.

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Item	Statement
PIIT3	I like to experiment with new information technology.
PIIT4a	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.

Table A1.2
Measurement Items and Scales for Non-Planning Nonusers (UT3) and Planning Nonusers (UT4) (Chroustová et al., 2017)

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.
EE3a	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.
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.

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Item	Statement
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
ATU1a	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.
ATU5a	Educational software should by only supplement of chemistry teaching.
ATU6a	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.
PIIT4a	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. Statements were worded with negation.

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Appendix 2

Table A2.1
Principal Component Analysis (PCA).

Code	All user Types		user type 1		user type 2			user type 3		user type 4		
PE	Performance Expectancy											
Factor	1		1		1			1		1		
Cronbach. alpha	.91		.92		.85			.86		.86		
Explained variance	85.09		86.25		77.05			78.21		78.47		
Eigenvalue	2.55		2.59		2.31			2.35		2.35		
PE1	.89		.90		.93			.79		.85		
PE2	.94		.95		.86			.91		.90		
PE3	.94		.94		.84			.94		.91		
EE	Effort Expectancy											
Factor	1		1		1			1		1		
Cronbach. alpha	.87		.84		.91			.85		.87		
Explained variance	79.63		76.54		84.67			76.87		80.06		
Eigenvalue	2.39		2.30		2.54			2.31		2.40		
EE1	.91		.87		.93			.93		.91		
EE2	.92		.93		.92			.92		.91		
EE3 (R)	.84		.82		.92			.78		.87		
FC	Facilitating Conditions											
Factor	1		1		1			1		1		
Cronbach. alpha	.74		.69		.74			.68		.70		
Explained variance	66.15		80.36		65.74			61.02		62.85		
Eigenvalue	1.98		1.61		1.97			1.83		1.89		
FC1	.84		.89		.91			.76		.77		
FC2	.82		.80		.80			.82		.79		
FC3	.78		.70		.71			.76		.82		
SI	Social Influence											
Factor	1	2	1	2	1	2	3	1	2	1	2	3
Cronbach. alpha	.90	.90	.87	.65	.90	.84	.68	.89	.91	.90	.88	.85
Explained variance	57.77	16.20	55.17	17.45	39.62	24.41	17.69	53.34	20.00	51.75	17.07	14.62
Eigenvalue	4.62	1.30	4.41	1.40	3.17	1.95	1.42	4.27	1.60	4.14	1.37	1.17
SI1	.88		.78		.97			.85		.94		
SI2	.88		.87		.93			.84		.91		
SI3	.92		.81		.82			.82		.91		
SI4	.87			-.42			.49	.79		.66		
SI5		.95		.64		.91			.82		.95	
SI6		.93		.67		.88			.80		.91	
SI7	.55		.76				.80	.69				.92
SI8	.65		.68				.93	.77				.90
ATU	Attitudes Towards Using											
Factor	1		1		1	2		1	2	1		
Cronbach. alpha	.82		.86		.82	.93		.71	.84	.74		
Explained variance	57.94		66.58		54.19	30.05		53.32	24.24	50.37		
Eigenvalue	3.48		3.33		2.71	1.50		2.67	1.21	3.02		
ATU1 (R)	.71		.56			-.96			.71	.59		
ATU2	.86		.89		.89			.78		.84		
ATU3	.86		.87		.95			.84		.86		
ATU4	.90		.91		.68			.83		.88		
ATU6 (R)	.79		.81			-.97			.61	.67		

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Code	All user Types	user type 1	user type 2	user type 3	user type 4
BI	Behavioural Intention				
Factor	1	1	1	1	1
Cronbach. alpha	.98	.95	.95	.95	.94
Explained variance	95.85	92.27	90.71	90.36	89.72
Eigenvalue	2.88	2.77	2.72	2.71	2.69
BI1	.97	.92	.92	.93	.91
BI2	.99	.98	.95	.97	.97
BI3	.99	.98	.98	.95	.96
USE	Use				
Factor	1	1	1	1	1
Cronbach.alpha	.89	.81	.64	.87	.79
Explained variance	82.12	73.77	59.11	80.09	71.40
Eigenvalue	2.46	2.21	1.77	2.40	2.14
USE1	.87	.82	.72	.88	.72
USE2	.94	.90	.84	.93	.91
USE3	.90	.86	.74	.87	.89
PIIT	Personal Innovativeness in IT				
Factor	1	1	1	1	1
Cronbach. alpha	.89	.88	.93	.84	.88
Explained variance	75.16	73.66	82.89	69.96	73.89
Eigenvalue	3.01	2.95	3.32	2.80	2.96
PIIT1	.89	.88	.89	.90	.86
PIIT2	.90	.87	.93	.90	.89
PIIT3	.93	.92	.96	.93	.93
PIIT4 (R)	.74	.77	.85	.58	.74
M	Motivation				
Factor	1	1	1	1	1
Cronbach. alpha	.88	.81	.87	.84	.84
Explained variance	67.82	58.15	67.66	61.55	62.23
Eigenvalue	3.39	2.91	3.38	3.08	3.11
M1	.76	.61	.86	.67	.71
M2	.77	.73	.61	.72	.76
M3	.88	.86	.93	.83	.85
M4	.91	.87	.92	.91	.86
M5	.80	.71	.76	.77	.77
PPI	Perceived Pedagogical Impact				
Factor	1	1	1	1	1
Cronbach. alpha	.93	.89	.90	.94	.92
Explained variance	66.65	56.31	59.92	69.22	63.48
Eigenvalue	5.33	4.51	4.79	5.54	5.08
PPI1	.76	.60	.83	.75	.77
PPI2	.85	.83	.73	.85	.82
PPI3	.80	.77	.71	.76	.80
PPI4	.83	.80	.80	.83	.83
PPI5	.82	.74	.68	.83	.80
PPI6	.82	.68	.73	.87	.82
PPI7	.84	.81	.87	.87	.80
PPI8	.81	.76	.83	.89	.72

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Appendix 3

Table A3.1
Differences in Scale Reliabilities of Constructs Reported as Cronbach's Alpha. (Chroustová et al., 2017)

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

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Appendix 4

Table A4.1
Factor Loadings (Measurement Model)

Construct	Item	All user Type	User type 1	User type 3	User type 4
Performance Expectancy (PE)	PE1	.85	—	.63	—
	PE2	.85	.96	.88	.87
	PE3	—	.91	.97	.87
Effort Expectancy (EE)	EE1	.92	.86	.91	.90
	EE2	.88	.88	.92	.85
	EE3	—	—	.61	.75
Facilitating Conditions (FC)	FC1	.63	.68	.48	.55
	FC2	.86	.89	.94	.81
	FC3	—	—	.49	.58
Social Influence (SI-o)	SI1	.92	.87	.96	.95
	SI2	.95	.96	.92	.94
	SI3	.85	.78	.88	.77
	SI4	.67	.61	.65	—
	SI7	—	.65	—	—
	SI8	—	.51	—	—
Social Influence of School (SI-s)	SI5	.86	.84	.85	—
	SI6	.96	.94	1.00	—
Attitude Towards Using (ATU)	ATU1	—	—	.76	—
	ATU2	.86	.87	.80	.81
	ATU3	.88	.84	.90	.87
	ATU4	.90	.91	.74	.88
	ATU5	—	—	—	—
	ATU6	—	.72	.72	—
Behavioural Intention (BI)	BI1	.93	.83	.88	.82
	BI2	.99	.99	.96	.99
	BI3	.99	1.00	.94	.95
Use (USE)	USE1	.81	.71	.84	.57
	USE2	.93	.85	.90	.88
	USE3	.85	.77	.80	.86
Personal Innovativeness in IT (PIIT)	PIIT1	.84	.81	.87	.81
	PIIT2	.86	.83	.85	.87
	PIIT3	.94	.93	.92	.93
	PIIT4	—	—	—	—
Motivation (M)	M1	.74	—	.60	.69
	M2	.67	.58	.61	.66
	M3	.85	.87	.77	.81
	M4	.90	.88	.93	.82
	M5	.71	.53	.71	.65
Perceived Pedagogical Impact (PPI)	PPI1	.73	—	.71	.77
	PPI2	.84	.84	.84	.81
	PPI3	.76	.70	.71	.79
	PPI4	.79	.78	.79	.79
	PPI5	.80	.73	.82	.77
	PPI6	.78	.57	.86	.76
	PPI7	.81	.74	.83	.74
	PPI8	.78	.65	.85	.66

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Appendix 5

Table A5.1
Measurement Model Validation (Convergent and Discriminant Validity With Correlations) for All Users

	CR	AVE	MSV	ASV	Correlations (discriminant validity)										
					PE	EE	FC	SI-s	SI-o	PIIT	M	PPI	ATU	BI	USE
PE	.84	.72	.67	.37	.85										
EE	.89	.81	.53	.18	.45	.90									
FC	.74	.49	.53	.24	.48	.73	.70								
SI-s	.91	.83	.30	.16	.45	.32	.55	.91							
SI-o	.90	.60	.32	.22	.57	.28	.40	.49	.77						
PIIT	.91	.78	.31	.18	.42	.51	.49	.17	.28	.88					
M	.88	.61	.58	.35	.76	.37	.41	.35	.54	.56	.78				
PPI	.93	.62	.58	.29	.69	.31	.31	.34	.47	.39	.76	.79			
ATU	.91	.77	.67	.36	.82	.39	.41	.38	.50	.42	.76	.71	.88		
BI	.98	.939	.46	.27	.60	.34	.51	.43	.53	.41	.54	.46	.57	.97	
USE	.90	.744	.62	.35	.72	.41	.50	.41	.51	.43	.67	.65	.79	.68	.86

Table A5.2
Measurement Model Validation (Convergent and Discriminant Validity With Correlations) for User Type 1

	CR	AVE	MSV	ASV	Correlations (discriminant validity)										
					PE	EE	FC	SI-s	SI-o	PIIT	M	PPI	ATU	BI	USE
PE	.93	.87	.38	.19	.93										
EE	.86	.76	.54	.17	.41	.87									
FC	.76	.62	.54	.16	.33	.73	.79								
SI-s	.86	.67	.24	.13	.42	.35	.47	.82							
SI-o	.88	.60	.24	.14	.42	.39	.22	.49	.78						
PIIT	.89	.73	.24	.11	.22	.43	.49	.07	.21	.86					
M	.82	.54	.64	.19	.45	.19	.16	.28	.43	.45	.74				
PPI	.89	.54	.64	.22	.49	.30	.17	.39	.44	.38	.80	.73			
ATU	.90	.70	.48	.25	.62	.34	.24	.36	.39	.29	.58	.67	.84		
BI	.96	.89	.35	.16	.43	.35	.42	.34	.28	.26	.32	.34	.53	.94	
USE	.82	.61	.48	.19	.48	.39	.41	.33	.28	.28	.35	.38	.69	.59	.78

Table A5.3
Measurement Model Validation (Convergent and Discriminant Validity With Correlations) for User Type 3

	CR	AVE	MSV	ASV	Correlations (discriminant validity)											
					PE	EE	FC	SI-s	SI-o	PIIT	M	PPI	ATU	ATUb	BI	USE
PE	.88	.71	.53	.19	.84											
EE	.86	.68	.48	.06	.03	.82										
FC	.69	.45	.48	.07	-.03	.69	.67									
SI-s	.92	.86	.08	.03	.14	.22	.29	.93								
SI-o	.88	.57	.23	.08	.35	-.17	.01	.29	.76							
PIIT	.86	.63	.22	.08	.09	.34	.39	.09	.13	.79						
M	.85	.54	.43	.17	.66	.05	.05	-.01	.35	.41	.79					
PPI	.93	.64	.31	.11	.56	-.05	-.11	-.01	.19	.11	.49	.73				
ATU	.85	.66	.53	.16	.73	.06	.01	.09	.27	.14	.58	.44	.80			
ATUb	.70	.54	.21	.06	.37	.08	.03	.05	.13	.10	.32	.34	.29	.81		
BI	.95	.86	.33	.11	.35	-.06	.03	.17	.48	.47	.40	.21	.21	.12	.74	
USE	.88	.72	.46	.22	.65	.16	.21	.18	.38	.38	.59	.53	.68	.46	.57	.93

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Table A5.4
Measurement Model Validation (Convergent and Discriminant Validity With Correlations) for User Type 4

	CR	AVE	MSV	ASV	Correlations (discriminant validity)									
					PE	EE	FC	SI-o	PIIT	M	PPI	ATU	BI	USE
PE	.87	.76	.47	.21	.87									
EE	.87	.70	.54	.17	.31	.84								
FC	.69	.43	.54	.17	.32	.74	.66							
SI-o	.92	.80	.13	.08	.36	.22	.29	.89						
PIIT	.91	.76	.29	.14	.31	.54	.41	.09	.87					
M	.85	.49	.54	.28	.68	.30	.35	.35	.35	.70				
PPI	.92	.58	.54	.26	.63	.42	.44	.34	.53	.74	.76			
ATU	.89	.73	.43	.23	.55	.35	.35	.27	.36	.65	.66	.85		
BI	.95	.86	.09	.05	.20	.26	.23	.23	.18	.22	.20	.20	.92	
USE	.82	.61	.39	.21	.48	.35	.39	.27	.31	.55	.63	.63	.30	.78

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