

# Value of Technology in Education: Exploring Factors Associated with Value Beliefs of Fundamental School Teachers in Luxembourg through a Survey Study

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**Abstract:** Information and Communication Technologies have impacted every business in the last decades. Education, as part of the knowledge business, has acknowledged the digital revolution and educational policy makers have tried to harness the powers of these new tools and to address the associated challenges, with more or less success. In Luxembourg, we have seen several attempts to help schools to strategically integrate ICT into everyday pedagogical activities. However, teacher beliefs associated with value of using technology (value beliefs) are rather understudied. The aim of this study was to document and understand technology acceptance of teachers to ensure successful technology integration. Quantitative data was collected through a survey of 127 teachers and analyzed through a mixed-method approach. Findings revealed both the dependence of value beliefs on perceived ease of use, subjective norms and a pedagogical approach and their independence from gender, age, experience, and school subject.

Nowadays, digital technologies are present and used in different organizations (Venkatesh et al., 2003, p. 426) and sectors: from entertainment and farming to medicine and education. The strong belief that “higher-level technology use will enhance every aspect of students’ learning experiences” (Hsu, 2016, p. 30) has turned ‘technology integration in the classroom’ into one of the leading education policy topics all over the globe. In Luxembourg these tendencies have been translated by public authorities into ‘Digital4Education’ and ‘Einfach Digital’ strategies dedicated to the improvement of the youth media literacy (Digital4Education, n.d.) and critical thinking, and to the wide use of the technology-based practices in schools (Einfach Digital, n.d.).

Most of the existing public policies and strategies are focused on eliminating first-order barriers, being extrinsic to actors and including “lack of access to software and inadequate technical and administrative support” (Ertmer 1999, p. 48). However, such technology integration policies and strategies do not always result in numerous and efficient ICT uses by key actors in education, such as teachers and students (Bice & Tang, 2022). To ensure the successful technology integration, technology acceptance is required (Venkatesh et al., 2003, p. 426), which can only be achieved by overcoming second-order or so-called ‘intrinsic’ barriers, in other words, by “challenging teachers’ belief system and institutionalized routines” (Ertmer, 1999, p. 48).

To help governments to investigate those belief systems and take corresponding decisions, a lot of studies on technology acceptance by teachers have been conducted in different countries. Technology integration in Luxembourg is still relatively understudied (see however Linckels, Kreis, Reuter, Dording, Weber & Meinel, 2009; Reuter, Busana, & Linckels, 2016). The aim of this paper is to shed light on beliefs of Luxembourgish fundamental school teachers to ensure the further development and implementation of efficient technology integration policies and strategies, as well as to inform decision-makers responsible for initial and continuous teacher training. Moreover, given the high penetration rate of ICT in the general population in Luxembourg,

studying technology acceptance in teachers here could shed light on the (potentially positive) effects of generalized technology acceptance in a society on its acceptance in a special subgroup of the population.

## Theoretical Framework

It is quite challenging to define teacher beliefs, as they often “travel in disguise and under alias-attitudes, values, judgments or perceptions” (Pajares, 1992, p. 309). Additionally, the educational technology integration research tends to narrow the understanding of teacher beliefs to technology-related beliefs (Hermans et al. 2008, p. 1499) and to neglect so-called fundamental pedagogical beliefs connected with either technology-related ones or the technology acceptance itself (Kim et al., 2013, p. 77).

All the above-mentioned categories of teacher beliefs represent fundamental constructs of this paper with a particular focus on value beliefs (subcategory of technology-related beliefs) which are often referred to as “perceived usefulness” or “performance expectancy” in the research models discussed further and defined as “beliefs about the value of technology for their teaching practice” (Vongkulluksn et al., 2018, p. 71).

Technology-related beliefs also include self-efficacy beliefs as “teachers’ judgments about their ability to either have success or failure performing certain actions” (Galvis, 2012, p. 99) which are explored under such constructs as “effort expectancy” or “perceived ease of use”.

The fundamental pedagogical beliefs studied in the present study are “beliefs about students and the learning process, teachers themselves, the curriculum” (Pajares, 1992), and efficient pedagogical strategies.

The construct which does not belong to any group of teacher beliefs but is vital for this paper is “social influence” or “subjective norm” considered as “perceived social pressure to perform or not to perform the behavior” (Pierce & Ball, 2009, p. 300). The vitality of this construct is connected with ideas that governmental institutions “can be thought of as geological forces that shape the general landscape” (Zhao & Frank, 2003, p.16) of the school, and thereby have some effect on how and to what degree teachers use technology, and beliefs that schools are ecosystems where teachers interact and “can exert pressure on each other to use computers or can provide contextualized information about their value and uses” (Zhao & Frank, 2003, p.17).

As mentioned above, the great research interest in the connections between ICT and education led to the appearance of diverse research models trying to discover factors of successful technology integration. Most of them are mainly dedicated to determinants of the behavior intention as the direct predictor of the technology use. Here only assumptions connected with different teacher beliefs, and especially with value beliefs as our main research interest, will be discussed, tested, and analyzed:

- The author of the Technology Acceptance Model (TAM) theorizes that perceived usefulness is influenced by perceived ease of use (Teo & Schaik, 2012, p. 180);
- According to the Unified Theory of Acceptance and Use of Technology (UTAUT) performance expectancy (perceived usefulness) is moderated by gender, age (Venkatesh et al., 2003, p. 446-447).

## Methodology

### Participants

The participants were recruited through convenient and snowball sampling techniques. The study sample included 127 representatives of all the categories of teaching personnel of Luxembourgish fundamental schools.

The majority of participants were female (89 respondents, 70%) and worked as Instituteurs (114 respondents, 89,7%) in C2 (51 respondents, 40%) or C4 (43 respondents, 33,8%) classes. The mean age range of teachers was between 30-39 (33 participants, 26%) and 40-49 (47 participants, 37%) years old. Levels of experience varied among teachers with 42,5% having 16-25 years of experience, and 37% having 6-15 years of professional experience. The most popular working locations of study participants were Differdange (28 respondents, 22,05%), Luxembourg (23 respondents, 18,11%), and Mamer (21 respondents, 16,54%).

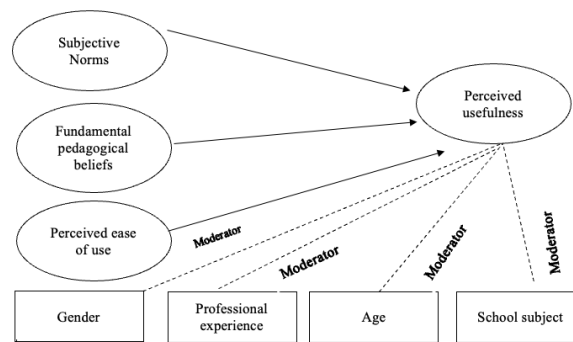
### Research Model and Hypotheses

With reference to the existing research models on ICT acceptance and integration mentioned in the previous sections, a new model of value beliefs (Fig.1) was developed for this study, and the following hypotheses were established and will be tested:

- *age, gender, professional experience and a school subject are moderators of value beliefs expressed through perceived usefulness (PU)*. This hypothesis was originally developed by the authors of the

Unified Theory of Acceptance and Use of Technology (UTAUT) (Venkatesh et al., 2003 p. 446-447). However, in the present study, these constructs were moderators of perceived usefulness rather than behavioral intention, and the categories of “experience” and ‘school subject’ were added to check if teacher beliefs “about the way the subject should be taught, and skills associated with competence in managing classroom activities and computer-handling technical skills” (Mumtaz, 2000, p. 337) moderated value beliefs.

- *subjective norms predict perceived usefulness of ICT;*
- *fundamental pedagogical beliefs predict perceived usefulness of ICT;*
- *perceived ease of use predicts perceived usefulness of ICT.*



**Figure 1: Research model**

### **Data Collection and Analysis**

Before data collection, approval of the Ethics Review Panel of the University of Luxembourg and authorization from the Ministry of Education to survey teachers were requested and granted. We did not collect any data that could directly identify participants; all the collected information was treated in an anonymous and confidential manner.

The survey was conducted through an online survey using the LimeSurvey platform hosted by the University of Luxembourg. In the present paper, we will present and analyze only a part of the larger survey, excluding items of the following sections: 1) personal and professional use of ICT; 2) facilitating conditions; 3) attitudes. Hence, the part of the survey presented and analyzed here included 14 items divided into 5 categories: 1) demographic information; 2) fundamental pedagogical beliefs; 3) subjective norms; 4) perceived ease of use; 5) perceived usefulness. Some of the items were adopted from Becker (2000) and from Brush et al. (2008), others were designed by the authors of the present study.

The survey respondents were mostly asked to express their degree of agreement/disagreement with the survey statements using a Likert-type scale ranging from totally agree (1) to totally disagree (5) or to choose one option which suited their beliefs best.

For the data analysis, different research methods were applied. The demographic information was summarised through descriptive statistics. For the rest of study constructs, mean “subcategory” scores of each respondent were calculated. Through correlation and regression analyses the study hypotheses were tested.

### **Findings**

#### **Age, Gender, Professional Experience, and School Subject are Moderators of Value Beliefs Expressed through Perceived Usefulness (PU)**

The mean PU score of female teachers is 3.65, and that of male teachers is 3.59. Together with the changes of the regression model ( $R^2$  .000, significant F change,  $p = .990$ ), these results indicate that gender cannot be considered as a moderator of value beliefs.

School subject means range from 2.59 (sports education) to 3.26 (mathematics), and 3.27 (German).  $R^2$  changes of the model falls between .000 (sports, values education) and .006 (media education), and significant F changes – between .125 (computational thinking) and .882 (values education), indicating that school subject is unlikely to moderate value beliefs.

The mean scores of perceived usefulness for teachers of different age and teaching experience categories (Tab.1) reveal an absence of significant differences between the beliefs of younger and older teachers, less or more experienced ones about the value of ICT for teaching and learning.

The changes of  $R^2$  (.002 for “age, and .12 for “experience”) and significant F changes ( $p = .503$  for “age”, and  $p = .107$  for “experience”) of the regression model after adding age and experience categories suggest an absence of a significant moderation effect.

Construct	Categories	Mean score
Age	19-29	3.82
	30-39	3.69
	40-49	3.53
	50-59	3.61
	60+	3.64
Experience	0-5	3.82
	6-15	3.69
	16-35	3.46
	36+	3.81

**Table 1:** Mean Scores of Perceived Usefulness among Teachers of Different Age and Experience Categories

### **Subjective Norms Predict Perceived Usefulness of ICT**

The results of the correlation and regression analyses suggest that moderate direct connections exist between the subjective norms and value beliefs,  $r(125) = .43$ ,  $p = 0.03$ . and that subjective norms could be considered as a predictor of perceived usefulness. It is worth mentioning that the “policy” component of subjective norms (public strategies) turns out to have closer ties with value beliefs,  $r(124) = .39$ ,  $p = < 0.01$ , than the “internal culture” component (attitudes and practices of coworkers, school administration),  $r(125) = .31$ ,  $p = < 0.01$ , and subjective norms have closer connections with value beliefs about learning,  $r(125) = .39$ ,  $p = < 0.01$ , than with those about their performance,  $r(124) = .31$ ,  $p = < 0.01$ .

### **Fundamental Pedagogical Beliefs Predict Perceived Usefulness of ICT**

Judged by the correlation coefficient and the statistical significance,  $r(125) = .48$ ,  $p = < 0.01$ , fundamental pedagogical beliefs are likely to predict perceived usefulness of technologies. Moreover, such beliefs are more correlated with teacher beliefs about learning,  $r(125) = .56$ ,  $p = < 0.01$ , than with those about personal performance,  $r(124) = .21$ ,  $p = 0.15$ .

### **Perceived Ease of Use Predicts Perceived Usefulness of ICT**

Findings suggest that perceived ease of use is the main predictor of value beliefs,  $r(125) = .50$ ,  $p = < 0.01$ . It is closely intersected with teacher beliefs about their own performance,  $r(124) = .56$ ,  $p = < 0.01$ , and less connected with ones about learning,  $r(125) = .36$ ,  $p = < 0.01$ .

## **Discussion**

Previous studies (see Hu et al., 2003) have discovered that perceived ease of use is one of the most important factors predicting perceived usefulness, and our findings support this idea. However, some papers challenge this statement mentioning that “the teacher might have the necessary self-efficacy beliefs, but still does not consider the technologies “easy” to use, because it is not easily applicable in the teaching/learning situation” (Sadeck, 2022, p. 10). The in-depth analysis of these intersections may present a topic of follow-up studies.

The technology integration research field is largely focused on studying connections between fundamental pedagogical beliefs and pedagogical approaches, which could be either teacher-centered or constructivist (Hsu, 2016, p.34) and the use of ICT in education. It is often suggested that technology-using teachers are more constructivist than non-using ones (Becker, 2000), and that the pedagogical approach has either

limited (Drent et al., 2008, p. 193) or significant (constructivist – positive, teacher-centered – negative) impact on innovative use of ICT (Hermans et al., 2008, p. 1506). The present study has established similar intersections between fundamental pedagogical beliefs and perceived usefulness of ICT in education. Among our study participants, 78 teachers shared constructivist beliefs, 34 – combined both pedagogical approaches, and 15 teachers preferred a teacher-centered approach. The mean scores of perceived usefulness of these categories (constructivist = 3.8; mixed = 3.6; teacher-centered = 2.86) together with the statistical findings suggest that a direct relationship between fundamental pedagogical beliefs and value beliefs, exists, which means that teachers with the constructivist approach are more likely to find technologies useful and to use them in their practices (Hsu, 2016).

Findings on subjective norms as a predictor of perceived usefulness are rather contradictory. Some studies show that subjective norms have a significant influence on perceived usefulness, but some of them fail to find these connections (Teo, 2011, p. 2437). Some authors try to explain such mixed findings by analyzing the environment where the studies were conducted and conclude that subjective norms are prone to impact value beliefs in more formal settings, such as schools (Teo, 2011, p. 2437). We found a direct moderate relationship between the environment and value beliefs. Interestingly, the political component consisting of recent public policies, strategies, and other initiatives has a more significant impact than long-term collegial interaction and collaborative support which are often meant by subjective norms (Mumtaz, 2000, p. 325). It may result from the active technology integration agenda in Luxembourg characterized by numerous public strategies and policies, meaning that strong public leadership (Walvatne, 2012, p. 30-32) and aligned vision on community goals (Howard, 2013) are more encouraging and empowering than practices of other teachers. Nonetheless, there are no studies to compare the obtained outcomes, so these ideas remain to be tested by future research.

The author of the UTAUT model has identified that both age and experience moderate key relationships in the model (dependent variable – behavioral intention): age through numerous categories including perceived usefulness, and experience through perceived ease of use (Venkatesh et al., 2003, p. 469). According to Kurt (2013), younger teachers use technologies more often and by themselves, and older and more experienced ones often need some help with computers and software. In accordance with results of the present study, neither age nor experience are likely to moderate value beliefs. Such differences may be due to diverse reasons. First, at least 10 years have passed since the referred studies were conducted, which means that a new generation of young teachers raised in the digital era might have appeared, and the older generation might have learned how to deal with technology. Hence, neither age nor experience could determine value beliefs, as ICT has become an integral part of the daily routines of a majority of the teaching personnel. Second, in this study, the dependent variable was changed from behavioral intention or actual usage to perceived usefulness, which could have resulted in opposite findings. It might thus be reasonable to investigate the moderating relationships with behavioral intention or actual usage as a dependent variable in a follow-up study to draw more nuanced conclusions.

Traditionally, women were believed not to be “strongly committed to their occupations” (Lopata, 1999, p. 242) or competitive. However, technology integration research suggests that “gender differences in the use of information technology may be transitory” (Venkatesh et al., 2003, p. 469) and the latest studies fail to discover gender differences in TPACK scores meaning that “gender gap may be closing” (Raper, 2018, p. 38). In the present study, gender could not be considered as a moderator of value beliefs either. Again, the appearance of a new, digital-age generation and the elimination of gender inequalities and stereotypes might have led to that.

According to our findings, languages (German) and mathematics have gained the most attention for technology integration which corresponds to the results of other studies (Hsu, 2016). However, the differences between school subjects are insignificant to consider them as a moderator of value beliefs. This could be due to the boom of applications and digital activities which enable the integration of technologies into the curriculum of any school subject.

## Conclusions

Results show that value beliefs, i.e., beliefs about the value of technology for teaching and learning are impacted by a set of factors, including (a) pedagogical approach and fundamental pedagogical beliefs, (b) public policies and internal culture of the school (components of subjective norms, and (c) perceived ease of use. The boom of technologies, digital devices, and applications has resulted in the insignificance of gender, age, experience, and subject for teachers' perception of the value of technology in education. Hence, efficient technology integration is achieved through conducting advanced teacher training on technology integration, ensuring the technology accessibility, and creating an aligned vision on technology integration goals and advantages at both public and institutional levels (Roblyer & Hughes, 2019).

## References

- Becker, H. J. (2000). Findings from the Teaching, Learning, and Computing Survey: Is Larry Cuban Right? *Education Policy Analysis Archives*, 8(51), 1–31.
- Bice, H., & Tang, H. (2022). Teachers' beliefs and practices of technology integration at a school for students with dyslexia: A mixed methods study. *Education and Information Technologies*, 27(7), 10179–10205. <https://doi.org/10.1007/s10639-022-11044-1>
- Brush, T., Glazewski, K. D., & Hew, K. F. (2008). Development of an Instrument to Measure Preservice Teachers' Technology Skills, Technology Beliefs, and Technology Barriers. *Computers in the Schools*, 25(1–2), 112–125. <https://doi.org/10.1080/07380560802157972>
- Digital4education. (n.d.). *Digital Luxembourg*. Retrieved February 6, 2023, from <https://digital-luxembourg.public.lu/initiatives/digital4education>
- Drent, M., & Meelissen, M. (2008). Which factors obstruct or stimulate teacher educators to use ICT innovatively? *Computers & Education*, 51(1), 187–199. <https://doi.org/10.1016/j.compedu.2007.05.001>
- Einfach digital. (n.d.). *Digital Luxembourg*. Retrieved February 6, 2023, from <https://digital-luxembourg.public.lu/initiatives/einfach-digital>
- Ertmer, P. A. (1999). Addressing first- and second-order barriers to change: Strategies for technology integration. *Educational Technology Research and Development*, 47(4), 47–61. <https://doi.org/10.1007/BF02299597>
- Galvis, H. A. (2012). Understanding Beliefs, Teachers' Beliefs and Their Impact on the Use of Computer Technology. *Profile Issues in Teachers' Professional Development*, 14(2), 95–112.
- Lopata, H. (1999). Gender and social roles. In *Handbook of the sociology of gender* (pp. 230–246). Springer.
- Hermans, R., Tondeur, J., van Braak, J., & Valcke, M. (2008). The impact of primary school teachers' educational beliefs on the classroom use of computers. *Computers & Education*, 51(4), 1499–1509. <https://doi.org/10.1016/j.compedu.2008.02.001>
- Howard, S. K. (2013). Risk-aversion: Understanding teachers' resistance to technology integration. *Technology, Pedagogy and Education*, 22(3), 357–372. <https://doi.org/10.1080/1475939X.2013.802995>
- Hsu, P. S. (2016). Examining Current Beliefs, Practices and Barriers About Technology Integration: A Case Study. *TechTrends*, 60(1), 30–40. <https://doi.org/10.1007/s11528-015-0014-3>
- Hu, P. J.-H., Clark, T. H. K., & Ma, W. W. (2003). Examining technology acceptance by school teachers: A longitudinal study. *Information & Management*, 41(2), 227–241. [https://doi.org/10.1016/S0378-7206\(03\)00050-8](https://doi.org/10.1016/S0378-7206(03)00050-8)
- Kim, C., Kim, M. K., Lee, C., Spector, J. M., & DeMeester, K. (2013). Teacher beliefs and technology integration. *Teaching and Teacher Education*, 29, 76–85. <https://doi.org/10.1016/j.tate.2012.08.005>
- Kurt, S. (2013). Examining teachers' use of computer-based technologies: A case study. *Education and Information Technologies*, 18(4), 557–570. <https://doi.org/10.1007/s10639-012-9199-7>
- Linckels, S., Kreis, Y., Reuter, R. A. P., Dording, C., Weber, C., & Meinel, C. (2009). Teaching with information and communication technologies: Preliminary results of a large scale survey. *Proceedings of the 37th Annual ACM SIGUCCS Fall Conference: Communication and Collaboration*, 157–162. <https://doi.org/10.1145/1629501.1629530>
- Mumtaz, S. (2000). Factors Affecting Teachers' Use of Information and Communications Technology: A review of the literature. *Journal of Information Technology for Teacher Education*, 9(3), 319–342.
- Pajares, M. F. (1992). Teachers' Beliefs and Educational Research: Cleaning Up a Messy Construct. *Review of Educational Research*, 62(3), 307–332. <https://doi.org/10.3102/00346543062003307>
- Pierce, R., & Ball, L. (2009). Perceptions that may affect teachers' intention to use technology in secondary mathematics classes. *Educational Studies in Mathematics*, 71(3), 299–317. <https://doi.org/10.1007/s10649-008-9177-6>
- Raper, R. C. (2018). The relationship between secondary teachers' technological pedagogical content knowledge and technology integration factors [Dissertation]. Liberty University.
- Reuter, R., Busana, G., & Linckels, S. (2016). Exploring the uses of ICT in education: A national survey study. *Presentation*. <https://doi.org/10.13140/RG.2.2.30999.57761>
- Roblyer, M. D., & Hughes, Joan. E. (2019). *Integrating Educational Technology into Teaching: Transforming Learning Across Disciplines* (8th ed.). Pearson Education.
- Sadeck, O. (2022). Technology Adoption Model: Is Use/Non-use a Case of Technological Affordances or Psychological Disposition or Pedagogical Reasoning in the Context of Teaching During the COVID-19 Pandemic Period? *Frontiers in Education*, 7, 906195. <https://doi.org/10.3389/feeduc.2022.906195>
- Teo, T. (2011). Factors influencing teachers' intention to use technology: Model development and test. *Computers & Education*, 57(4), 2432–2440. <https://doi.org/10.1016/j.compedu.2011.06.008>
- Teo, T., & van Schaik, P. (2012). Understanding the Intention to Use Technology by Preservice Teachers: An Empirical Test of Competing Theoretical Models. *International Journal of Human-Computer Interaction*, 28(3), 178–188. <https://doi.org/10.1080/10447318.2011.581892>
- Venkatesh, Morris, Davis, & Davis. (2003). User Acceptance of Information Technology: Toward a Unified View. *MIS Quarterly*, 27(3), 425–478. <https://doi.org/10.2307/30036540>
- Vongkulluksn, V. W., Xie, K., & Bowman, M. A. (2018). The role of value on teachers' internalization of external barriers and externalization of personal beliefs for classroom technology integration. *Computers & Education*, 118, 70–81. <https://doi.org/10.1016/j.compedu.2017.11.009>
- Walvatne, J. M. (2012). *The role of teacher belief systems in technology integration* [A Graduate Review]. University of Northern Iowa.
- Zhao, Y., & Frank, K. A. (2003). Factors Affecting Technology Uses in Schools: An Ecological Perspective. *American Educational Research Journal*, 40(4), 807–840.