



Competencies and beliefs of Swiss teachers with regard to the modular curriculum 'Media and ICT'

Marina Grgic*

University of Teacher Education, Bern, Pädagogische Hochschule Bern (PH Bern), PHBern, Bern, Switzerland

ARTICLE INFO

Keywords:

Theory of planned behaviour
Media and information literacy
Curriculum implementation
Teacher professional development
Teachers' competencies

ABSTRACT

Ajzen's Theory of Planned Behaviour emphasises that a person's beliefs and competencies are crucial in terms of their behavioural intentions. When transferred to the implementation of a new curriculum, it can thus be hypothesised that teachers' competencies and beliefs would be the core antecedents of a successful implementation. The context of this study is the new module curriculum 'Media and ICT (M&I)' that was introduced in the German-speaking part of Switzerland in 2017. It requires teachers to possess media didactics and technological competencies. This study investigates the current state of teachers' competencies as well as their beliefs about the new module curriculum M&I. In addition, the relationship between these competencies and beliefs and the teachers' intention to implement this new curriculum in the classroom is tested. An online survey was administered to 203 teachers. The results show that teachers' competencies only have an indirect effect on their intention to teach M&I when it is mediated by their beliefs (i.e., their readiness to innovate and self-efficacy). Direct effects were found between teachers' readiness and their M&I-related self-efficacy and their intention to implement the new curriculum in their classrooms. The current study contributes to the promotion of digitalisation in the educational field by highlighting the effects of teachers' beliefs and their competencies. Regarding practical relevance, the findings of this study can guide and support the professionalisation of teachers and their initial and further training pertaining to M&I.

1. Introduction

As a response to the ongoing digital transformation that affects all areas of everyday life, digital and media-related content is also increasingly being integrated into school curricula, and teachers are being asked to teach this content to students. This development is also taking place in Switzerland, the country where the present study was conducted. Swiss authorities launched the implementation of a new module curriculum 'Media and ICT' (M&I)¹ in public schools in all of the 21 German-speaking cantons of Switzerland in 2017 (Educa.ch, 2020). This school reform brought new requirements for teachers in terms of learning content and the didactics of digital literacy. Studies show that teachers and their beliefs about reforms, as well as their competencies, contribute to the curriculum's implementation process in schools in an essential way (Waffner, 2020). Therefore, in this study, teachers are

considered to be key personnel for the successful implementation of the new M&I module curriculum. Fitria and Suminah (2020, p. 71) refer to teachers as "agent[s] of change", as they can evoke changes in a positive manner that is needed for a reform, contribute to its implementation or, on the contrary, dampen or completely hamper it. In this context of the module curriculum implementation process, their competencies, and in particular the beliefs of the teachers, play an important role (Educa, 2021). As the M&I reform process has not yet been completed and no data are available on the monitoring of implementation, this study aims to address this research gap and intends to take a closer look at teachers as agents of change during the implementation process. More concretely, to what extent the teachers' beliefs and competencies are related to their intention to implement M&I in their teaching is investigated. The findings of the study deepen the current knowledge of Ajzen's (1991) Theory of Planned Behaviour, in which, in addition to

* Correspondence to: Institut für Forschung, Entwicklung und Evaluation, Schwerpunkt: Governance im System Schule, Büro 109, Länggassstrasse 35, 3012 Bern, Switzerland.

E-mail address: marina.grgic@phbern.ch.

¹ In international discourse, the term "Media and Information Literacy" is common (Frau-Meigs et al., 2017). The term "Media and ICT" (M&I), which is common in Switzerland, refers to all aspects of media and information technology education, as does the international term. Therefore, this term will be used in the following sections.

<https://doi.org/10.1016/j.ijedro.2023.100288>

Received 29 March 2023; Received in revised form 27 September 2023; Accepted 27 September 2023

Available online 30 September 2023

2666-3740/© 2023 The Author(s). Published by Elsevier Ltd. This is an open access article under the CC BY license (<http://creativecommons.org/licenses/by/4.0/>).

beliefs, competencies are added to the model to further understand the intention towards behaviour. This examination may reveal areas where teachers' beliefs and competencies are inconsistent with reform efforts, thereby enabling reformers and curriculum developers to target potentially problematic conflicts.

2. Teachers as actors of change for the implementation of the M&I module in Switzerland

In the research on national curriculum implementation, the bottom-up view of curriculum reform plays an important role. Here, the teacher is seen as the central actor in the change process, "as it is teachers, who the real effects that individual political decisions finally have in practice and the success or failure of the implementation of a reform, hinge on" (Dostál, Wang, Nuangchalerm, Brosch, & Steingartner, 2017 p. 3). An important aspect of this research area is the psychological processes that influence teachers' behaviour (Underwood, 2012). Research indicates that educational developments may encounter resistance from teachers in the school context (e.g., Wallace & Priestley, 2011). Among other things, the relationship between teachers' views and the introduction of ICT subjects or the expansion of curricula plays an important role in whether they support, accept or reject curricular innovations (e.g., Webb & Cox, 2004). Moreover, the M&I module curriculum met resistance from many stakeholders in Switzerland. Some initiatives even called for a computer-free classroom (e.g., Kanton Bern, 2016). This perception is not very conducive to the implementation process, as the Swiss Department of Economics, Education and Research (Departement für Wirtschaft, Bildung und Forschung, 2017, p. 57) has pointed out that the digital transformation in schools will only take place if teachers are convinced that this transformation is important for students' life in society in general. However, this can only succeed (Departement für Wirtschaft, Bildung und Forschung, 2017) if teachers not only have positive beliefs about digitalisation and M&I but also have the M&I competencies to drive this school improvement forward.

Consequently, teachers' beliefs and M&I competencies about the current reform efforts need to be examined. However, there has been no empirical investigation of the beliefs and M&I competencies of teachers yet in the context of the implementation process of this new module curriculum. Therefore, in the context of a larger Swiss National Science-funded project 'reform@work (Grant #188867), this study aims to find out to what extent teachers' beliefs and competencies are related to their intention to implement M&I in their teaching².

3. Teachers' ICT and media competencies and beliefs as influential factors for the implementation of the M&I curriculum

In addition to the studies about reform processes in schools, in the context of digitalisation processes at schools, the term 'teacher readiness' is used to describe the possibility, willingness and motivation of teachers to integrate digital resources into their teaching. The extent of this readiness and the success of its use depends on two characteristics: their competencies and beliefs (Educa, 2021). Studies suggest that teachers who are convinced of the added value of digital resources are crucial for those digital resources to be used in a pedagogically meaningful manner (Educa, 2021). It has also emerged that despite significant investments in digital technologies over the past 30 years, the extent of their use in schools is low (Ertmer, 2005; Eickelmann & Vennemann, 2017). Teachers who do not have the sufficient skills to integrate digital resources into their teaching or who are convinced that such integration will have no effect or even a negative effect on teaching and learning tend not to use the existing resources effectively (Ertmer, 2005; Petko

et al., 2018; Vannatta & Fordham, 2004).

Further, teachers' M&I competencies are presented in more detail in Sections 3.1, and 3.2 will focus on teachers' beliefs. Section 3.3 reports on the current empirical state regarding teachers' competencies and their beliefs related to ICT and the use of digital tools³.

3.1. Teachers' competencies related to the M&I curriculum

Various theoretical models and approaches are available regarding the knowledge that the teachers need to act professionally in the context of digitisation in schools. In the international context, the European Commission developed the European Framework for the Digital Competence of Educators (DigCompEdu). DigCompEdu captures and describes 22 elementary competencies divided into six sub-areas: Professional Engagement, Digital Resources, Teaching and Learning, Evaluation, Learner Orientation and Advancing Learners' Digital Competencies (Caena & Redecker, 2019). This framework can be used to support the development of (national) digital competence models. Compatible with the European reference framework is the Technological Pedagogical and Content Knowledge (TPACK) model (Mishra & Koehler, 2006). The TPACK model offers the possibility of capturing requirements for the teachers in ICT teaching, focussing on their professional knowledge (Schmid et al., 2020). It differentiates three different types of knowledge that form the basis for mastering digital transformation in the classroom: Technological Knowledge (TK), Content Knowledge (CK) and Pedagogical Knowledge (PK). TK refers to knowledge related to hardware, software and associated devices, as well as the use of digital media (e.g., creating an online blog or using a streaming platform). PK defines knowledge related to the pupils' learning behaviours, structuring instruction (e.g., creating a problem-based lesson), the knowledge of different learning theories and the evaluation of the pupils' performance regardless of the content made available to them. Lastly, CK refers to knowledge about the subject without including pedagogical-didactic considerations, such as the knowledge related to the basic functioning of search engines (Link & Nepper, 2021). The overlap of these knowledge types extends the model to include Pedagogical Content Knowledge (PCK), Technological Content Knowledge (TCK), Technological Pedagogical Knowledge (TPK) as well as Technological Pedagogical Content Knowledge (TPACK). Thus, PCK refers to the knowledge involved in teaching content knowledge in the classroom (e.g., a lesson on how to use different search engines). The knowledge about the existence and characteristics of different technologies as well as forms of instruction without reference to a specific content, such as distance learning, is understood as TPK, while TCK is the knowledge about how technologies and digital support services can be used to present content in different ways. The last knowledge type TPACK is defined as the "knowledge of how to use different digital media to teach and learn specific subject content" [translated by the Author], i.e., delivering a lesson that involves creating a blog post about using search engines (Nepper, 2021, p. 145).

The challenge that arises for educational systems with different curricula is to translate these models to the specific national context. Numerous countries have already addressed this challenge by developing competency models for teachers based on the DigCompEdu and/or TPACK models that incorporate contextual specificities at the national or regional level (e.g., The Norwegian Digital Competence Framework for Teachers, see Rubio et al., 2019). Recent reviews indicate that the applicability of TPACK for a competency assessment is valid (e.g., Binder & Cramer, 2021). In the Swiss context, the M&I

² The overall project is still ongoing and is the only one in Switzerland investigating the implementation of the M&I module curriculum. Therefore, this investigation is not only up to date but also unique.

³ As the M&I module curriculum is only taught in Switzerland in its form, the current empirical state of research refers to similar subjects or curricula [e.g., Information and Communication Technology (ICT) or Science, Technology, Engineering and Mathematics Education (STEM)] or to the use of digital tools during teaching.

competency model was developed for the first time as part of the introduction of the M&I module curriculum (Grgic, 2023). The M&I competency model distinguishes between four different competency facets: Application Knowledge, Content Knowledge, Didactics of M&I and Interdisciplinary Pedagogical and Didactical Knowledge. Application Knowledge includes the ability of teachers to handle the devices, program on their own, recognise and describe system or technical errors, perform administrative tasks digitally and be familiar with data handling. Content Knowledge summarises the knowledge of the basics of media and computer science education (i.e., recognising cyber bullying). The facet Didactics of M&I is understood as the ability of teachers to use the module curriculum and then to design (interdisciplinary) lessons from it as well as to use current and appropriate tools, methods and teaching materials. Further, Interdisciplinary Pedagogical and Didactical Knowledge includes the knowledge of the basic didactic principles. The didactic principles involve, for example, dealing with heterogeneity in the classroom and encouraging pupils to think and act independently. To investigate teachers' M&I competencies, the M&I competency model will be applied for the first time in this study.

3.2. Teachers' beliefs and Ajzen's theory of planned behaviour

Understanding and predicting teachers' behaviour in the context of digitalisation has been a central focus of educational research (e.g., Prasse, 2012). In this context, the Technology Acceptance Model (TAM) (Davis, 1989) and the Theory of Planned Behaviour (TPB) (Ajzen, 1992) have emerged as influential models for elucidating behaviour related to technology acceptance and general behavioural intentions, respectively. The TAM (Davis, 1989) aims to explain how individuals accept and adopt information technology. It posits that two main factors influence an individual's intention to use technology: perceived usefulness and perceived ease of use. In contrast, the TPB, developed by Ajzen in 1991, offers a broader perspective on behavioural intentions. The TPB posits that behavioural intentions are influenced by three main factors: attitude towards the behaviour, subjective norms, and perceived behavioural control. The TPB provides a comprehensive framework for understanding and predicting a wide range of behaviours. By accounting for social pressure and support, the TPB provides a more in-depth understanding of behaviour. In addition, the TPB incorporates the concept of perceived behavioural control, which recognises that individuals' beliefs about their ability to control their behaviour influence their intentions. This factor increases the predictive power of the TPB by accounting for self-perceived constraints on or facilitators of behaviour. Although more recent models of the TAM, called TAM3 (Venkatesh et al., 2003), have included additional external variables to address this research desideratum, the very limited concept of attitude continues to be criticised (Straub, 2009). Since the TPB integrates both individual and social factors and acknowledges the influence of subjective norms on behavioural intentions, it seems more appropriate for the present study. Recognising the benefits of the TPB, the upcoming study will contribute to the growing research on curricular changes regarding digitalisation in schools (Dostál et al., 2017) by applying this theoretical framework to teachers' intentions to teach M&I and thus implement the new M&I curriculum module. Ajzen's Theory of Planned Behavior (1991) has been used as a theoretical framework to examine teacher behaviour in a number of studies (e.g., Wu et al., 2022; Strelow et al., 2020). Ajzen (1991) assumes as mentioned before, three components that together impact the behavioural intention: the attitude towards the behaviour, the subjective norm and the perceived behavioural control.

First, *attitude towards behaviour* refers to the personal conviction regarding the intended behaviour. In the school context, it can be explained by the readiness to innovate. Prasse (2012, p. 50f.) defines readiness to innovate as "a general personal disposition regarding openness [...] to innovative behaviour [...]" [translated by the Author].

Emmrich (2010) adds that the content of the pedagogical innovation can refer to the development and/or application of new teaching

materials, teaching concepts and changed framework conditions. In the context of the implementation of the module curriculum M&I, pedagogical innovation takes place, for example, by creating new framework conditions by establishing two annual weekly lessons in cycles two and three⁴ (Deutschschweizer Erziehungsdirektorenkonferenz, 2015) or by creating new teaching materials closely tied to new teaching concepts. Finally, the willingness for further education in the field of M&I is also part of the readiness to innovate.

Second, the *subjective norm* describes the perceived social desirability of the intended behaviour (Ajzen, 1991). In the context of M&I, this could mean that the principal demands and promotes M&I and is strongly committed to digitalisation at their school. At the same time, the teacher attaches great value to the demands and views of the principal or that the whole team in the teacher's school attaches great importance to digitalisation and that everyone is interested in adequately introducing and implementing the M&I module curriculum. Therefore, the value that is attributed to implementing M&I into classroom teaching by the significant others in the school context (e.g., the principal and the colleagues) can be described as the 'subjective norm'.

The third component – perceived behavioural control – describes the conviction of having the desired behaviour under control and carrying it out. Ajzen (1991) assumes that the more positive the subjective conviction is towards the target behaviour, the more likely it is that the behaviour will be carried out. The perceived behavioural control is most compatible with Bandura's (1977) concept of self-efficacy. Self-efficacy refers to a person's conviction that they can cope with new or difficult situations and challenges with their own strengths (Bandura, 1977). A significant finding of Bandura (1977) was that people usually only start an action if they are convinced that they can indeed master it successfully. In this study, the introduction of the M&I module curriculum is seen as a new challenge, as it is an unfamiliar new subject area for many teachers. Emmrich (2010) emphasises the relevance of self-efficacy expectations and cites empirical studies (e.g., Edelstein, 2002; Schwarzer & Jerusalem, 2002) that state teachers' self-efficacy expectations as a central aspect in the context of innovation. For example, Schwarzer and Jerusalem (2002) assume that teachers with low self-efficacy expectations tend to prefer easy and safe teaching activities, as they feel overwhelmed by innovative planning and have little confidence in themselves. In contrast, teachers with high self-efficacy expectations are more willing to try out new materials and innovative didactic approaches, while showing a greater willingness to experiment with methods (Allinder, 1994; Guskey, 1984).

Ajzen (2011) points out that in TPB, information about the determinants of a behaviour is contained in a person's behavioural, normative and controlling beliefs. The theory points to a variety of personal or demographic variables that may influence individuals' beliefs. Ajzen (2011) assumes that these factors influence intentions and behaviour indirectly through their effects on the proximate determinants of the theory. The fact that the introduction and integration of ICT strongly depend on the characteristics of the teachers, such as their age and gender, has already been pointed out in previous studies (e.g., Lawrence & Tar, 2018). As the research findings related to the differences between teachers' gender and age in terms of their intention to teach ICT are different (e.g., Gómez-Trigueros & Yáñez de Aldecoa, 2021; Kollia et al., 2020), they are used as control variables in the present study without any prior assumption.

⁴ The Swiss education system divides mandatory schooling into three cycles: the first cycle covers kindergarten and grades 1 and 2 of primary school. The second cycle comprises grades 3 to 6 of primary school. The third cycle comprises grades 7 to 9 which constitute lower secondary education in Switzerland (Bildungsdirektoren-Konferenz Zentralschweiz [BKZ] Geschäftsstelle, 2022).

3.3. Empirical state of research on teachers' competencies and beliefs regarding M&I

Overall, attitudes toward ICT and TPACK play a crucial role in technology integration in schools and have been the focus of many empirical studies (e.g., Backfisch et al., 2020; Liu, 2011; Sang et al., 2010). Many studies have investigated either only the influence of TPACK (e.g., Yang et al., 2021) or the influence of the beliefs (TPB) (e.g., Teo et al., 2016) of the (preservice) teachers on their intention to teach ICT or use different digital tools in the classroom. Again, other studies gathered both theoretical constructs but did not put them in a concrete relation (e.g., Sointu et al., 2017). Other research findings (Backfisch et al., 2020) only show the relationship between one individual component of TPB (in that study: self-efficacy) and teacher knowledge (TPACK). Thus, the authors were able to demonstrate that the self-reported technological knowledge predicted teachers' self-efficacy (Backfisch et al., 2020). Due to the differing scientific discourse, a review study (Bürger et al., 2021) was conducted. Bürger et al. (2021) summarised empirical findings between 2010 and 2020 on the role of TPB in relation to the use of digital technologies in teaching. The researchers found a significant positive effect of beliefs on the intention to use and the actual use: the stronger the beliefs are, the more likely teachers are to use technology in the classroom. However, this literature review did not include studies that also examined teachers' competencies in this area.

In the last decade, TPACK and TPB have increasingly been surveyed in a combined manner in studies. Studies that have examined both theoretical constructs include Habibi et al. (2022) and Cheung and Cheung Tse (2021). The former found that attitude ($\beta = .778$) and technological knowledge ($\beta = .396$) had strong significant influences on teachers' behavioural intention whereas subjective norms and perceived behavioural control had no significant influence on whether the teachers taught STEM. In comparison, Habibi et al. (2022) obtained divergent results. In this study, the subjective norm was the strongest predictor ($\beta = .445$), followed by perceived behavioural control ($\beta = .281$). TPACK facets as well as attitude were estimated to be insignificant regarding the teachers' intention to use technology. These different results could be due to the fact that the subjective norm, depending on the prevailing culture in a country, can be classified as more or less significant in predicting an intention. Likewise, the differences can also be attributed to the degree to which the use of digital tools in the classroom or teaching ICT is required (Yang et al., 2021).

The study addresses the research gap by linking both constructs (beliefs and competencies). In addition, mediation can be assumed since Bandura (1977) also speaks of competence beliefs in the context of self-efficacy expectations. This indicates that the expectation of self-efficacy stems from the belief in one's competence. This means that having the required competencies to successfully complete a task will probably lead to higher self-efficacy beliefs. On the other hand, low competence can lead to low self-efficacy beliefs. Schwarzer and Jerusalem (2002) also assume that evaluating one's own effort and its results, i.e., the presence or absence of competence, promotes self-efficacy beliefs. Therefore, in the present study, it is assumed that the influence of competence is mediated by self-efficacy and thus leads to behavioural intention. Similarly, this study assumes that competence mediates behavioural intention through the willingness to innovate since individuals with greater knowledge or competence are also more likely to be willing to use this knowledge in their M&I teaching. Prasse (2012) notes that in the area of ICT use by teachers, it is assumed that some conditions, such as willingness to innovate, have a moderating or mediating influence on the relationships postulated in the TPB and/or may have a direct effect on behaviour. Therefore, in the context of this study, it is believed that high M&I competence can boost a teacher's confidence to try out new ideas and use innovative approaches with conviction in their M&I teaching. If a teacher feels that they lack sufficient M&I competence to innovate, they may be less open to new

teaching approaches and thus have no intention of teaching M&I.

4. Research question and hypotheses

The following main question was addressed to meet the purpose of the current study: What is the relationship between teachers' beliefs and competencies and their intention to teach M&I? It is assumed that the teachers' M&I-related competencies are directly associated with their readiness to innovate (Hypothesis 1), their self-efficacy (H2) and the intention to teach M&I (H3). Furthermore, it is expected that teachers who show a high readiness to innovate (H4), who have high self-efficacy beliefs (H5) and who teach in a school team with support that is conducive towards M&I (H6) are more willing to form a behavioural intention (e.g., teachers wanting to implement the M&I modular curriculum). Furthermore, it is assumed that there are indirect effects of competencies on the intention to teach M&I, mediated by the teachers' self-efficacy (H7) and their readiness to innovate (H8). In addition, the role of the background variables 'gender' and 'age' (which represent the control variables) on their intention to teach M&I were investigated. Fig. 1 depicts the full model for the proposed study.

5. Method

5.1. Design and sample

A cross-sectional design was applied. Teachers filled in an online survey between November 2021 and January 2022. Participation was voluntary. The teachers were assured that their data would remain anonymous, and 203 Swiss teachers teaching classes from kindergarten to sixth grade participated in this study. They were selected because they belonged to the school grades that were affected by the reform. The teachers also participated in the larger research project 'reform@work'. The teachers were between 22 and 63 years old ($M = 39.91$, $SD = 10.56$). Also, 166 (81.8%) were female, 36 (17.7%) were male and one (0.5%) was non-binary. Their average working experience was 15 years ($M = 15.08$; $SD = 10.30$).

5.2. Measures

5.2.1. Self-perceived M&I competencies

Teachers' M&I competencies were examined by relying on the M&I competency model (Grgic, 2023). This competency model is structured according to four different competency facets: Application Knowledge, Content Knowledge, Didactics of M&I and Interdisciplinary Pedagogical and Didactical Knowledge⁵. An example item for the competence facet 'Content Knowledge' is 'I can explain how data can be lost and know the most important measures to avoid this'⁶. The participants were asked to rate 30 items on a scale from 1 (*strongly disagree*) to 5 (*strongly agree*).

5.2.2. Beliefs

Here, *Teacher's attitude towards behaviour* was operationalised using the scale 'readiness to innovate' developed by Emmrich (2010; 5 items; 1 = *not true* to 4 = *very true*; e.g., 'I want to integrate M&I into my teaching, even if it means more effort'). The scale 'subjective norm' refers to the M&I school context (adapted from Papanastasiou & Angeli, 2008; Scholl & Prasse, 2000; Teo, 2011; 9 items; 1 = *strongly disagree* to 4 = *strongly agree*; e.g., 'The team at our school shows great interest in the M&I module curriculum'). The teachers' perceived behavioural control was operationalised by assessing the teachers' self-efficacy regarding M&I using the items of teachers' self-efficacy expectations based on

⁵ After statistical checks on the validity of the M&I competency model, the four competency facets were reformulated (see Chapter on 'Data Analysis').

⁶ All items presented in this paper were translated from German to English by the author.

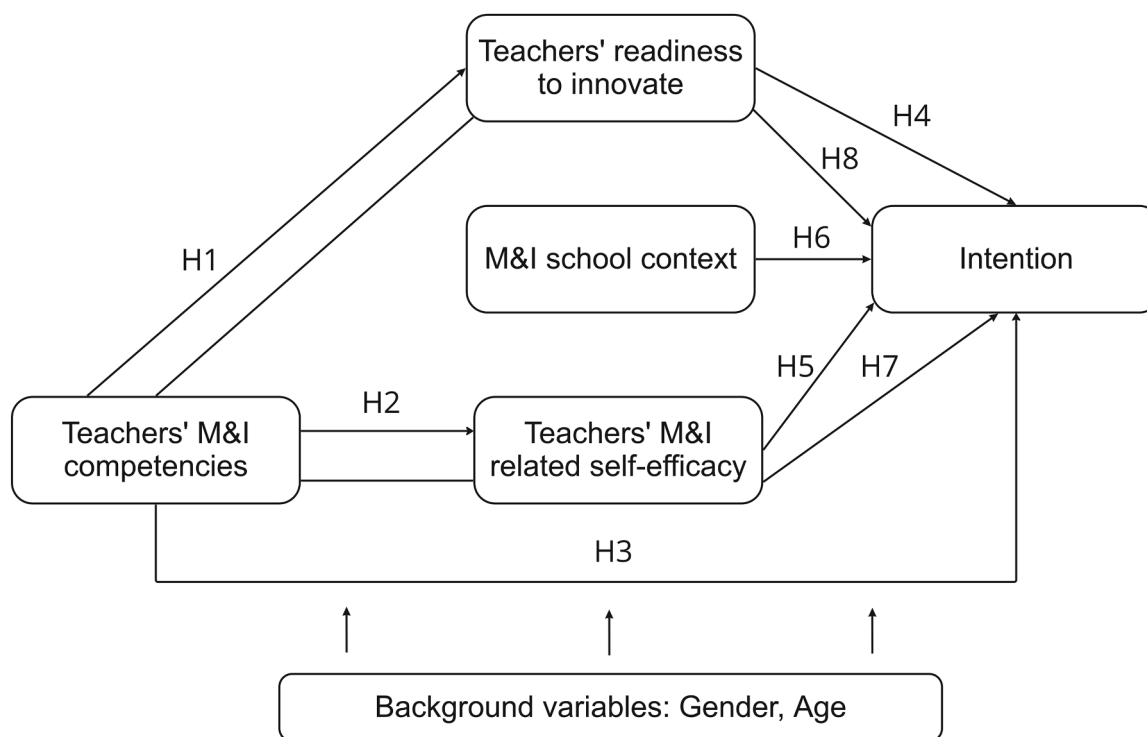


Fig. 1. Model design

Pfitzner-Eden et al. (2014) (10 items; 1 = *not at all convinced*; 9 = *completely convinced*; e.g., 'How confident are you in your ability to create lessons related to the M&I module curriculum?').

5.2.3. Behaviour intention

The 14 items of the scale of 'behaviour intention' [adapted according to the specifications from Ajzen (1991) and Francis et al. (2004)] were adapted to fit the context of the M&I module curriculum (3 items; 1 = *strongly disagree* to 4 = *strongly agree*; e.g., 'I am confident that I will be teaching M&I this school year').

5.2.4. Age and gender

Based on Ajzen's (1991) suggestion, the influence of background variables on teachers' intention to teach M&I were also assessed in this study. To do this, teachers indicated their gender [*'male'* (0), *'female'* (1) or *'nonbinary'* (2)]. For the analysis, only male and female teachers were considered, as the group of "non-binary" teachers was too small ($n = 1$). Teachers indicated their age in years.

5.3. Data analysis

The completed data from the survey was entered into the Statistical Package for Social Science IBM SPSS Statistics (Version 27) (Pallant, 2016) before being transferred to MPLUS 8.6 (Muthén & Muthén, 1998–2021) for further analysis. A maximum likelihood estimator (MLR) was used, which provides standard errors and a chi-square test statistic that are robust to non-normality and nonindependence of observations. The number of missing values per item was low, reaching a maximum of 5.9% in one of the competency facets scales. No systematic missing patterns were revealed. Missing values were estimated by using the full information maximum likelihood (FIML) procedure.

Data analysis consisted of three main steps. First, the construct validity (confirmatory factor analyses) and reliability of the measures (Cronbach's alpha) were assessed. After that, descriptive statistics and intercorrelations were computed. In a third and final step, the hypotheses were tested by applying SEM examining the relationships between

teachers' beliefs, competencies and behavioural intentions.

The fitness of the SEM for this study was checked using chi-square (χ^2), the comparative fit index (CFI), the standardised root-mean-square error of approximation (RMSEA) and the standardised root mean square residual (SRMR) (Schermelleh-Engel et al., 2003).

6. Results

6.1. Confirmatory factor analyses and reliability of the used measures

In the confirmatory factor analyses (CFA) and the subsequent SEM, item parcelling was applied as the sample size was not too large. In this study, the latent variable 'subjective norm' was constructed into three parcels. By applying item parcelling to the analysis, the reliability and relationships with other variables was improved and the model was less complex (Matsunaga, 2008). For the latent variable 'M&I competency', the four competency facets were used as indicators for the subscales to model M&I competency. Two minor changes were made to increase the validity of the model. The original competency facet 'Application Knowledge' was renamed to 'ICT Knowledge and Application', and 'Content Knowledge' was renamed to 'Media Literacy Knowledge and Application'. The items about the basics of computer science education, which previously belonged to the competency facet 'Content Knowledge', were now moved to the facet 'ICT Knowledge and Application'.

As depicted in Table 1, the fit indices of all measurement latent variables were satisfactory. Also, the internal consistency (Cronbach's Alpha) proved to be high.

6.2. Descriptive statistics and intercorrelations

Descriptive statistics and bivariate correlations between the latent and control variables are displayed in Table 2. Overall, the M&I competency facets have been rated medium to high, regarding the empirical mean and all competency facets correlate positively weakly to strongly with each other (Cohen, 1988).

Regarding TPB beliefs, it can be stated that teachers had medium

Table 1
Fit indices of latent constructs: Factor Analyses and Cronbach's alpha values.

Latent Variables	Cronbach's α	χ^2	p	CFI	RMSEA	SRMR
M&I competencies	.93	5.43	.065	.980	.093	.032
Readiness to innovate (attitude towards behaviour)	.75	2.84	.241	.996	.046	.018
M&I school context (subjective norm)	.82	.00	.000	1.000	.000	.000
Teachers' M&I-related self-efficacy (perceived behavioural control)	.91	54.63	.007	.969	.060	.041
Intention	.89	86.07	.029	.960	.062	.051

Note. chi-square (χ^2), comparative fit index (CFI), the standardised root-mean-square error of approximation (RMSEA), standardised root mean square residual (SRMR).

scores regarding their self-efficacy in the area of M&I as well as for their readiness to innovate and the perceived subjective norm. Further, teachers' beliefs correlate positively with each other. These are medium to strong effects (Cohen, 1988).

The correlations between M&I competency (as well as competency facets) and teachers' beliefs can be indicated as significantly moderate to strong (Cohen, 1988). The participating teachers indicated a moderate to strong tendency to teach M&I in the future. This dependent variable correlates significantly weak to strong with all variables. The strongest positive correlation is found between 'Intention' and 'M&I competencies'.

6.3. Teachers' competencies and beliefs and their relationship with behavioural intention - applying SEM

In order to test the proposed conceptual model (see Fig. 1), structural equation modelling was applied. The model fit showed to be an acceptable fit ($\chi^2 = 938.523$; $df = 541$; $p = <.001$; CFI = 0.882; RMSEA = 0.061 [90% CI = 0.055/0.068]; SRMR = 0.086).

The results revealed direct association between teachers' M&I competencies and their readiness to innovate ($\beta = .693$, $p < 0.001$) and

between teachers' M&I competencies and their M&I-related self-efficacy ($\beta = .693$, $p < 0.001$). Hence, hypotheses 1 and 2 were supported. However, there was no direct association between teachers' M&I competencies and their intention to teach M&I ($\beta = .117$, $p = .319$; rejection of hypothesis 3). Significant relations were observed between teachers' readiness to innovate and the teachers' behavioural intention ($\beta = .318$, $p < 0.01$), their M&I related self-efficacy and behavioural intention ($\beta = .337$, $p < 0.01$). Thus, hypotheses 4 and 5 were supported. No significant relation could be detected between the teachers' perceived subjective norm (i.e., M&I school context) and behavioural intention ($\beta = .209$, $p = .146$), which leads to the rejection of hypothesis 6.

Further, indirect significant effects were found from teachers' competencies mediated via their self-efficacy ($\beta = .233$, $p < 0.01$) and their readiness to innovate ($\beta = .221$, $p < 0.01$) on their intention to teach M&I, which confirm hypotheses 7 and 8.

Concerning teachers' gender and age, the results provide additional explanations about teachers' intention to teach M&I. Male teachers were found to be more positive in their behavioural intention than female teachers ($\beta = .139$, $p < 0.01$). Furthermore, older teachers formed less of an intention to teach M&I than their younger colleagues ($\beta = -.102$, $p = .069$), even if this result just missed the significance level. Altogether, 70.8 % of the variance in teachers' behavioural intention to teach M&I in the classroom was explained by the model (see Fig. 2).

7. Discussion

The complexity of the factors influencing teachers' intention to teach M&I, and thus what influences the decision to implement the new M&I module curriculum, cannot be overstated. Ajzen (1991) conceptualised intention towards a behaviour as a product of three interrelated beliefs. The results of this study partly confirm Ajzen's (1991) conceptualisation of the theory of planned behaviour as the attitude towards the behaviour (readiness to innovate) and the perceived behavioural control (teachers' self-efficacy) affecting the teachers' intention to teach M&I. These beliefs correspond to previous studies that explain their importance for a desired behaviour (e.g., Emmrich, 2010). As can be derived from the results of this study, the teachers are open to the new module curriculum and show a high readiness to innovate. Likewise, the self-efficacy expectation in this subject seems to have a positive effect on their intention to teach M&I. This result is consistent with the findings of Cheung and Cheung Tse (2021). The subjective norm (M&I school context) is not directly related to teachers' intention to teach M&I, as shown by the results of this study and also by Cheung and Cheung Tse

Table 2
Number of items (I), means (M), standard deviation (SD), the range of the items and bivariate correlations between the variables.

Model	I	n	M	SD	Range	1	a)	b)	c)	d)	2	3	4	5	6	7
1. M&I competencies	30	198	3.73	0.60	1.41–5.00	–					.69***	.73***	.69***	-.37***	.14	.75***
a) ICT Knowledge and Application	9	193	3.63	0.65	1.11–5.00		–	.59***	.62***	.39***	.56***	.52***	.49***	-.37***	.10	.60***
b) Media Knowledge and Application	5	192	4.15	0.44	1.20–5.00			–	.53***	.43***	.45***	.36***	.39***	-.29***	.08	.38***
c) Didactics of M&I	8	183	3.26	0.70	1.00–5.00				–	.27***	.57***	.73***	.65***	-.26***	.15	.69***
d) Interdisciplinary Pedagogical and Didactical Knowledge	5	193	4.30	0.47	2.00–5.00					–	.34***	.19*	.26**	-.06	-.00	.25**
2. Readiness to innovate	4	201	2.88	0.51	1.00–4.00						–	.65***	.48***	-.15*	.07	.70***
3. M&I school context	9	201	2.88	0.50	1.00–3.89							–	.55***	-.27***	.07	.707***
4. M&I-related self-efficacy	10	203	5.77	1.39	1.00–9.00								–	-.25**	.17*	.71***
5. Age	1	200	39.91	10.56	22–63									–	.13*	-.29***
6. Gender															–	.23**
7. Intention	14	203	4.42	1.06	1.64–7.00											–

Note. The competency facets (a–d) are part of the M&I competency, that is, the overall competency, which is why correlations are not computed.

* $p \leq 0.05$.
 ** $p < 0.01$.
 *** $p < 0.001$.

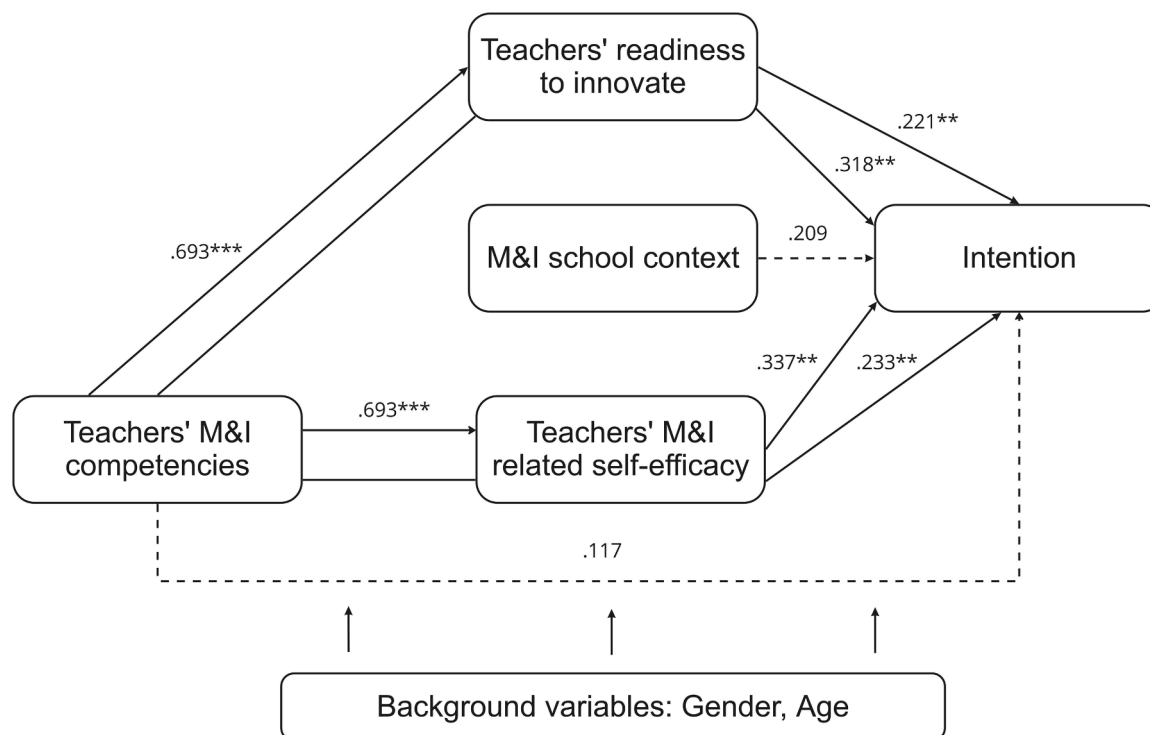


Fig. 2. Interrelations between teachers' M&I competencies, their beliefs and their intention to teach M&I – results from an SEM. Note. * $p \leq 0.05$; ** $p < 0.01$; *** $p < 0.001$. Dashed lines show non-significant effects.

(2021). This result does not support Ajzen's (1991) theory or the literature review (e.g., Bürger et al., 2021), as teachers of the previous study did not seem to be bothered whether their school team sympathises with the new module curriculum, and/or they did not attach great value to the demands and views among their team of M&I. Furthermore, the study was also able to show that teachers' M&I competencies affect their self-efficacy expectations and their readiness to innovate.

The study was further able to demonstrate that the assessment of two different theoretical constructs (TPB and M&I competency model) proved to be viable. Even though teachers' competencies do not affect their intention to teach M&I directly, the results show an indirect effect via their readiness to innovate and their M&I-related self-efficacy. In line with previous empirical findings (Backfisch et al., 2020; Caena, 2011; European Commission, 2013), positive significant correlations between competencies and beliefs were found in this study. This result also underlines the mediating effect between competencies and self-efficacy as well as the teachers' readiness to innovate. The findings presented suggest that changing beliefs and developing teachers' M&I competencies are vital to promote the intention to teach M&I and finally to implement the M&I module curriculum in its fullness. Although subjective norm has no significant effect on the teachers' intention to teach M&I, this very absent effect is an argument that regardless of the prevailing M&I school culture, teachers' competencies, self-efficacy expectations and readiness to innovate can be fostered to implement the M&I module curriculum.

The relationship between gender and teachers' intention to teach M&I was also noteworthy. The results of the present study indicate that male teachers have a more positive intention than female teachers. This finding probably suggests that male teachers will be more open to teaching M&I than their female counterparts. This finding coincides with that of previous studies that have reported that women are continuously underrepresented in the IT sector, both in Switzerland and in Europe (Bundesamt für Statistik, 2022; Eurostat, 2022). This is caused, partially, by a lack of gender equity in the informatics field (e.g., Buser et al., 2017; Carlana, 2019). In this sense, the potential to inspire

girls in the future to the IT field through the M&I module curriculum is seen; on the other hand, teachers, universities and the education departments of the cantons must take on the responsibility to develop and implement the necessary concepts and measures in the training and continuing education of teachers to promote female students (ICT Switzerland: Kommission Bildung, 2020).

The second background variable 'age' showed in the results such that older teachers were less likely to intend to teach M&I than their younger colleagues. Although this result is not significant, it is still not unexpected, as this 'digital generation gap' has already been found in previous studies. In this regard, studies (Raman & Yamat, 2014; Williams, 2012) show that the generation gap in relation to technology indicates the difference in terms of attitude towards technology between 'Generation X'⁷ teachers and their digital native pupils.

8. Study limitations

As with any study, this study comes with some limitations. First, the teachers surveyed were in the middle of the implementation phase of the M&I module curriculum in their schools. At the time of the survey, the obligation to teach M&I had not yet been established as well as control by the school inspectorate. Teachers may be more willing to implement M&I instruction when these external mechanisms are in effect. Thus, an investigation at the end of the implementation phase should follow, comparing teachers' intentions during the process and after the completion of the implementation phase.

Moreover, the present study focused on Ajzen's theory of planned behaviour (1991) by taking teachers' competencies and beliefs in order to take behavioural intention into account. These variables are a selection since it can be assumed that teachers' behavioural intentions can also be influenced by other factors. More concretely, further research

⁷ According to Oblinger and Oblinger (2005), 'Generation X' refers to teachers born between 1965 and 1982.

could include variables, such as the type and duration of professional training, collaboration among teachers, ICT infrastructure, leadership styles and so on. For further and deeper insights, for understanding teachers' intention to teach M&I and also to receive supplemental insights into the quantitative findings, qualitative methods should be included in future research (e.g., interviews, diaries). Using such methods, it would be possible to explore important additional information based on teachers' own words and personal experiences (Sointu et al., 2017). Finally, the present survey is a cross-sectional study, which does not allow testing for causal relations between beliefs, competencies and intentions. Thus, future studies could take advantage of the potential of longitudinal research and launch such a study. By utilising a longitudinal design, researchers could also investigate the change in teachers' beliefs and competencies with the upcoming obligation to teach M&I (Yang et al., 2021).

Even though the study offers insights into the competencies and beliefs of teachers in the context of introducing the new M&I module curriculum, it remains unclear to what extent the results can be transferred or generalised at the international level in the context of digitalisation in education.

9. Conclusion and study implications

The present study provides an overview of teachers' perceived competencies and their beliefs regarding the new M&I module curriculum. These findings are highly significant, as they can be used as a starting point for developing tailor-made programmes for in-service training. However, it is not only the M&I competencies of teachers that should be addressed in education and training. As the study shows, beliefs contribute an important part of teaching M&I in the future. Therefore, the focus should be given to developing positive attitudes among teachers. In order to foster the intention to teach M&I and thus contribute to the implementation of the M&I module curriculum, teachers' competencies, self-efficacy expectations, and willingness to innovate should be promoted. Focusing on beliefs and related experiences can be a useful approach to enhancing teachers' professional development (Borko, 2004). According to Bandura (1977), self-efficacy can be promoted by four sources: one's own experiences of success, vicarious experiences, verbal encouragement, and positive emotional as well as psychological states. The research conducted by Odanga et al. (2018) focuses on Bandura's thoughts (1997). It includes the following practical recommendations for promoting teachers' self-efficacy: a supportive and non-autocratic leadership style, praise for good work, recommendations for promotions, and effective delegation of tasks (Odanga et al., 2018, p. 10). This recommendation indicates that school leaders play an important role and can greatly enhance teachers' self-efficacy, thereby facilitating the implementation of M&I.

In terms of theoretical relevance, the present study contributes to the field of curriculum implementation (e.g., Wallace & Priestley, 2011) and extends these findings to a highly relevant context: the introduction of an ICT and media-supported curriculum in Switzerland. Similar curriculum implementations can be observed worldwide. It shows that Ajzen's Theory of planned behaviour (1991) and the context-specific M&I competency model (Grgic, 2023) can be a fruitful theoretical analytical perspective for curriculum change processes by demonstrating how teachers' competencies and beliefs are related to implementation.

Disclosure statement

No potential conflict of interest was reported by the author.

Declaration of Competing Interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: Marina Grgic reports financial support was provided by Swiss

National Science Foundation. Marina Grgic reports a relationship with University of Teacher Education Berne that includes: employment.

Funding

This work was supported by the larger Swiss National Science-funded project 'reform@work' (Grant #188867).

Acknowledgments

A sincere thank you, to all the researchers of the project, all the stakeholders of the participating schools in the project 'reform@work' and my two supervisors.

References

- Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes*, 50, 179–211.
- Ajzen, I. (2011). The theory of planned behaviour: Reactions and reflections. *Psychology & Health*, 26(9), 1113–1127. <https://doi.org/10.1080/08870446.2011.613995>
- Allinder, R. M. (1994). The relationship between efficacy and the instructional practices of special education teachers and consultants. *Teacher Education and Special Education: The Journal of the Teacher Education Division of the Council for Exceptional Children*, 17(2), 86–95. <https://doi.org/10.1177/088840649401700203>
- Backfisch, I., Lachner, A., Hische, C., Loose, F., & Scheiter, K. (2020). Professional knowledge or motivation? Investigating the role of teachers' expertise on the quality of technology-enhanced lesson plans. *Learning and Instruction*, 66, 1–13. <https://doi.org/10.1016/j.learninstruc.2019.101300>
- Bandura, A. (1977). Self-efficacy: Toward a unifying theory of behavioral change. *Psychological Review*, 84(2), 191–215. <https://doi.org/10.1037/0033-295X.84.2.191>
- Bandura, A. (Ed.). (1997). *Self-efficacy in changing societies*. Cambridge, England: Cambridge University Press.
- Bildungsdirektoren-Konferenz Zentralschweiz (BKZ) Geschäftsstelle (Ed.). (2022, August 15). *Konzept: Lehrplan 21*. <https://www.lehrplan21.ch/konzept>.
- Binder, K., & Cramer, C. (2021). Digitalisierung in der Fachliteratur zum Lehrer*innenberuf. *Herausforderung Lehrer*innenbildung - Zeitschrift zur Konzeption, Gestaltung und Diskussion*, 4(1), 329–343. <https://doi.org/10.11576/HLZ-4518>
- Borko, H. (2004). Professional development and teacher learning: Mapping the terrain. *Educational Researcher*, 33(8), 3–15. <https://doi.org/10.3102/0013189X033008003>
- Bundesamt für Statistik. (2022). *IKT-Ausbildung*. <https://www.bfs.admin.ch/bfs/de/home/e/statistiken/kultur-medien-informationsgesellschaft-sport/informationsgesellschaft/gesamtindikatoren/bildungswesen-bibliotheken/ikt-ausbildung.html>.
- Bürger, N., Haselmann, S., Baumgart, J., Prinz, G., Girnat, B., Meisert, A., Menthe, J., Schmidt-Thieme, B., & Wecker, C. (2021). Jenseits von Professionswissen: Eine systematische Übersichtsarbeit zu einstellungs- und motivationsbezogenen Einflussfaktoren auf die Nutzung digitaler Technologien im Unterricht. *ZfE (Zeitschrift Für Erziehungswissenschaft)*, 24(5), 1087–1112. <https://doi.org/10.1007/s11618-021-01050-3>
- Buser, T., Peter, N., & Wolter, S. C. (2017). Gender, competitiveness, and study choices in high school: Evidence from Switzerland. *American Economic Review*, 107(5), 125–130. <https://doi.org/10.1257/aer.p20171017>
- Caena, F. (2011). *Literature review. Teachers' core competences: Requirements and development*. Brussels, Belgium: European Commission.
- Caena, F., & Redecker, C. (2019). Aligning teacher competence frameworks to 21st century challenges: The case for the European Digital Competence Framework for Educators (DigCompEdu). *European Journal of Education*, 54(3), 356–369.
- Carlane, M. (2019). Implicit stereotypes: Evidence from teachers' gender bias. *The Quarterly Journal of Economics*, 1163–1224. <https://doi.org/10.2139/ssrn.3217475>
- Cheung, H. C., & Cheung Tse, A. W. (2021). Hong Kong science in-service teachers' behavioural intention towards STEM education and their technological pedagogical content knowledge (TPACK). In *Tale2021: IEEE international conference on engineering, technology & education: 5–8 December 2021, Wuhan, China: Conference proceedings* (pp. 630–637). IEEE. <https://doi.org/10.1109/TALE52509.2021.9678933>.
- Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd ed.). Lawrence Erlbaum Associates, Publishers.
- Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly*, 13, 319–340.
- Departement für Wirtschaft, Bildung und Forschung. (07.2017). *Herausforderungen der Digitalisierung für Bildung und Forschung in der Schweiz*. Staatssekretariat für Bildung, Forschung und Innovation (SBFI).
- Deutschschweizer Erziehungsdirektorenkonferenz. (2015). *Lehrplan 21: Druckfertige Fassung liegt vor*. April 2. Luzern.
- Dostál, J., Wang, X., Nuangchaleram, P., Brosch, A., & Steingartner, W. (2017). Researching computing teachers' attitudes towards changes in the curriculum content — An innovative approach or resistance?. In *Towards better competencies of ICT human resources and regional competitiveness in a global era: Aston Hotel and Convention Center, Jayapura, Papua, Indonesia, 1–3 November 2017* (pp. 1–6). IEEE. <https://doi.org/10.1109/IAC.2017.8280531>.
- Edelstein, W. (2002). Selbstwirksamkeit, Innovation und Schulreform. Zur Diagnose der Situation. In M. Jerusalem, & D. Hopf (Eds.), *Selbstwirksamkeit und*

- Motivationsprozesse in Bildungsinstitutionen (pp. 13–27). Beltz. <https://doi.org/10.25656/01:3929>.
- Educa. (2021). *Digitalisierung in der Bildung: Bericht im Auftrag des Staatssekretariats für Bildung, Forschung und Innovation (SBFI) und der Schweizerischen Konferenz der kantonalen Erziehungsdirektoren (EDK) im Rahmen des Bildungsmonitorings*. Bern: Educa.
- Educa.ch. (2020). *Lehrpläne*. <https://www.educa.ch/de/digitalisierung-bildung/Lehrpläne>.
- Eickelmann, B., & Vennemann, M. (2017). Teachers' attitudes and beliefs regarding ICT in teaching and learning in European countries. *European Educational Research Journal*, 16(6), 733–761.
- Emmrich, R. (2010). *Motivstrukturen von Lehrerinnen und Lehrern in Innovations- und Transferkontexten*. Berliner Beiträge zur Pädagogik. Peter Lang.
- Ertmer, P. A. (2005). Teacher pedagogical beliefs: The final frontier in our quest for technology integration? *Educational Technology Research and Development*, 53, 25–39.
- European Commission. (2013). *Supporting teacher competence development for better learning outcomes*. European Commission.
- Eurostat (Ed.). (2022). *Erwerbstätige IKT-Spezialisten nach Geschlecht*. August 18. Europäische Kommission https://ec.europa.eu/eurostat/de/web/products-datasets/product?code=isoc_sks_itps.
- Fitria, H., & Suminah, S. (2020). Role of teachers in digital instructional era. *Journal of Social Work and Science Education*, 1(1), 70–77. <https://doi.org/10.52690/jswse.v1i1.11>
- Francis, J., Eccles, M. P., Johnston, M., Walker, A. E., Grimshaw, J. M., Foy, R., Kaner, E. F. S., Smith, L., & Bonetti, D. (2004). *Constructing questionnaires based on the theory of planned behaviour: A manual for health services researchers*. Centre for Health Services Research, University of Newcastle upon Tyne.
- Frau-Meigs, D., Velez, I., & Michel, J. F. (2017). *Public policies in media and information literacy in Europe: Cross-country comparisons*. *Routledge studies in European communication research and education*. Routledge. <https://doi.org/10.4324/9781315628851>
- Gómez-Trigueros, I. M., & Yáñez de Aldecoa, C. (2021). The digital gender gap in teacher education: The TPACK framework for the 21st century. *European Journal of Investigation in Health, Psychology and Education*, 11(4), 1333–1349. <https://doi.org/10.3390/ejihpe11040097v>
- Grgic, M. (2023). Digitale Kompetenz von Lehrpersonen für den Medien- und Informatikunterricht in der Schweiz. *PFLB – PraxisForschungLehr*innenBildung*, 5(1), 18–35. <https://doi.org/10.11576/pflb-6102>
- Guskey, T. R. (1984). The influence of change in instructional effectiveness upon the affective characteristics of teachers. *American Educational Research Journal*, 21(2), 245–259. <https://doi.org/10.3102/00028312021002245>
- Habibi, A., Razak, R. A., Yusop, F. D., Muhaimin, M., Asrial, A., Mukminin, A., & Jamila, A. (2022). Exploring the factors affecting pre-service science teachers' actual use of technology during teaching practice. *South African Journal of Education*, 42(1), Article 1955. <https://doi.org/10.15700/saje.v42n1a1955>
- ICT Switzerland: Kommission Bildung. (2020). *Positionspapier: Für die digitale Zukunft - Mehr Frauen in die Informatik*, 1–9.
- Kanton Bern (2016). *Parlamentarischer Vorstoss. Antwort des Regierungsrates: Chancen und Risiken einer Digitalisierung der Volksschulen*.
- Kollia, A., Saprikis, V., & Antoniadis, I. (2020). ICT in the educational process: Teachers' perceptions based on their age and years of service. In *7th International conference on new ideas in management, economics & accounting*. <https://doi.org/10.33422/7th.imea.2020.02.10>. Rome, Italy.
- Lawrence, J. E., & Tar, U. A. (2018). Factors that influence teachers' adoption and integration of ICT in teaching/learning process. *Educational Media International*, 55(1), 79–105. <https://doi.org/10.1080/09523987.2018.1439712>
- Link, N., & Nepper, H. H. (2021). Über das TPACK-Professionswissen angehender Lehrkräfte zum Einsatz digitaler Medien im Technikunterricht. *Journal of Technical Education*, 9(2), 143–167.
- Liu, S.-H. (2011). Modeling pre-service teachers' knowledge of, attitudes toward, and intentions for technology integration. In *Paper presented at the EdMedia: World conference on educational media and technology*. Lisbon.
- Matsunaga, M. (2008). Item parceling in structural equation modeling: A primer. *Communication Methods and Measures*, 2(4), 260–293. <https://doi.org/10.1080/19312450802458935>
- Mishra, P., & Koehler, M. J. (2006). Technological pedagogical content knowledge: A framework for teacher knowledge. *Teachers College Record*, 108(6), 1017–1054.
- Muthén, L. K., & Muthén, B. O. (1998). *Mplus User's Guide*. -2021 (8th ed.). Muthén & Muthén.
- Oblinger, D., & Oblinger, J. (2005). Is it age or IT: First steps toward understanding the net generation. In D. Oblinger, & J. J. Oblinger (Eds.), *Educating the Net generation*. EDUCAUSE.
- Odanga, S., Raburu, P., & Aloka, P. (2018). Strategies for enhancing teachers' self-efficacy in secondary schools. *Asian Research Journal of Arts & Social Sciences*, 6(2), 1–13. <https://doi.org/10.9734/ARJASS/2018/38486>
- Pallant, J. (2016). *SPSS Survival Manual* (6th ed.). Allen and Unwin.
- Papanastasiou, E., & Angeli, C. (2008). Evaluating the use of ICT in education: Psychometric properties of the survey of factors affecting teachers teaching with technology (SFA-T3). *Educational Technology & Society*, 11, 69–86.
- Petko, D., Döbeli Honegger, B., & Prasse, D. (2018). Digitale Transformation in Bildung und Schule: Facetten, Entwicklungslinien und Herausforderungen für die Lehrerinnen- und Lehrerbildung. *Beiträge zur Lehrerinnen- und Lehrerbildung*, 36(2), 157–174.
- Pfitzner-Eden, F., Thiel, F., & Horsley, J. (2014). An adapted measure of teacher self-efficacy for preservice teachers: Exploring its validity across two countries. *Zeitschrift für Pädagogische Psychologie*, 28(3), 83–91.
- Prasse, D. (2012). *Bedingungen innovativen Handelns in Schulen: Funktion und Interaktion von Innovationsbereitschaft, Innovationsklima und Akteursnetzwerken am Beispiel der IKT-Integration an Schulen*. Empirische Erziehungswissenschaft. Waxmann.
- Raman, K., & Yamat, H. (2014). Barriers teachers face in integrating ICT during English lessons: A case study. *The Malaysian Online Journal of Educational Technology*, 2(3), 11–19.
- Rubio, J. C. C., Engen, B. K., & Gassó, H. H. (2019). Digital competence for teachers: Perspectives and foresights for a new school. *Communicar*, 27(61), 1–3.
- Sang, G., Valcke, M., van Braak, J., & Tondeur, J. (2010). Student teachers' thinking processes and ICT integration: Predictors of prospective teaching behaviors with educational technology. *Computers & Education*, 54(1), 103–112. <https://doi.org/10.1016/j.compedu.2009.07.010>
- Schermelleh-Engel, K., Moosbrugger, H., & Müller, H. (2003). Evaluating the fit of structural equation models: Tests of significance and descriptive goodness-of-fit measures. *Methods of Psychological Research Online*, 8, 23–74.
- Schmid, M., Krannich, M., & Petko, D. (2020). Technological pedagogical content knowledge. Entwicklungen und Implikationen. *Journal für LehrerInnenbildung*, (1), 116–124. https://doi.org/10.35468/jlb-01-2020_10
- Scholl, W., & Prasse, D. (2000). *Internetnutzung an Schulen - Organisationsbezogene Evaluation der Initiative 'Schulen ans Netz (SaN). Abschlussbericht für die Initiative 'SaN'/BMBF*. Institut für Psychologie. Humboldt-Universität Berlin.
- Schwarzer, R., & Jerusalem, M. (2002). Das Konzept der Selbstwirksamkeit. In M. Jerusalem, & D. Hopf (Eds.), *Selbstwirksamkeit und Motivationsprozesse in Bildungsinstitutionen* (pp. 28–51). Beltz. <https://doi.org/10.25656/01:3930>.
- Sointu, E., Valtonen, T., Cutucache, C. E., Kukkonen, J., & Lambert, M. C. (2017). *Differences in preservice teachers' readiness to use ICT in education and development of TPACK*. Association for the Advancement of Computing in Education (AACE). In *Proceedings of society for information technology & teacher education international conference*.
- Straub, E. T. (2009). Understanding technology adoption: Theory and future directions for informal learning. *Review of Educational Research*, 79(2), 625–649.
- Strelow, A. E., Dort, M., Schwinger, M., & Christiansen, H. (2020). Influences on pre-service teachers' intention to use classroom management strategies for students with ADHD: A model analysis. *International Journal of Educational Research*, 103, Article 101627. <https://doi.org/10.1016/j.ijer.2020.101627>
- 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., Zhou, M., & Noyes, J. (2016). Teachers and technology: Development of an extended theory of planned behavior. *Educational Technology Research and Development*, 64(6), 1033–1052. <https://doi.org/10.1007/s11423-016-9446-5>
- Underwood, P. R. (2012). Teacher beliefs and intentions regarding the instruction of English grammar under national curriculum reforms: A Theory of Planned Behaviour perspective. *Teaching and Teacher Education*, 28(6), 911–925. <https://doi.org/10.1016/j.tate.2012.04.004>
- Vannatta, R. A., & Fordham, N. (2004). Teacher dispositions as predictors of classroom technology use. *Journal of Research on Technology in Education*, 36(3), 253–272.
- Venkatesh, V., Morris, M. G., Davis, G. B., & Davis, F. D. (2003). User acceptance of information technology: Toward a unified view. *MIS Quarterly*, 27(3), 425–478.
- Waffner, B. (2020). Unterrichtspraktiken, Erfahrungen und Einstellungen von Lehrpersonen zu digitalen Medien in der Schule. In A. Wilmers, C. Anda, C. Keller, & M. Rittberger (Eds.), *Digitalisierung in der Bildung: Band 1. Bildung im digitalen Wandel: Die Bedeutung für das pädagogische Personal und für die Aus- und Fortbildung* (pp. 57–102). Waxmann. <https://doi.org/10.31244/9783830991991.03>.
- Wallace, C. S., & Priestley, M. (2011). Teacher beliefs and the mediation of curriculum innovation in Scotland: A socio-cultural perspective on professional development and change. *Journal of Curriculum Studies*, 43(3), 357–381. <https://doi.org/10.1080/00220272.2011.563447>
- Webb, M., & Cox, M. (2004). A review of pedagogy related to information and communications technology. *Technology, Pedagogy and Education*, 13(3), 235–286. <https://doi.org/10.1080/14759390400200183>
- Williams, R. W. (2012). *Digital immigrant teacher perceptions of social media as it influences the affective and cognitive development of students: A phenomenological study*. Liberty University Scholar Crossings.
- Wu, Di, Yang, X., Yang, W., Lu, C., & Li, M. (2022). Effects of teacher- and school-level ICT training on teachers' use of digital educational resources in rural schools in China: A multilevel moderation model. *International Journal of Educational Research*, 111, Article 101910. <https://doi.org/10.1016/j.ijer.2021.101910>
- Yang, J., Wang, Q., Wang, J., Huang, M., & Ma, Y. (2021). A study of K-12 teachers' TPACK on the technology acceptance of E-schoolbag. *Interactive Learning Environments*, 29(7), 1062–1075. <https://doi.org/10.1080/10494820.2019.1627560>