The effects of online professional development on higher education teachers' beliefs and intentions towards learning facilitation and technology

Abstract An important development in higher education is the increased learning possibilities brought by ICT. Many academics seem reluctant to embrace technology. An online teacher training program was followed by 73 academics from nine higher educational institutions. Data were gathered using the Technological Pedagogical Content Knowledge (TPACK) model and the Teacher Beliefs and Intentions questionnaire using a pre-post test-design. The results amongst 33 participants who completed both pre- and post-test indicate that TPACK skills increased substantially. Over time academics were less convinced about the merits of knowledge transmission. Disciplines and institutional cultures, time investment and beliefs towards employability influenced training retention.

1. Introductions

An important development in higher education is the increased learning possibilities afforded by Information Communication Technology (ICT) that, if used effectively, have been shown to provide a powerful learning experience for students (Brouwer, Ekimova, Jasinska, Van Gastel, & Virgailaite-Meckauskaite, 2009; Löfström & Nevgi, 2008; Rienties, Tempelaar, Van den Bossche, Gijselaers, & Segers, 2009; Volman, 2005). A consequence may be that traditional teaching methods become questioned as expectations change. For example, students are now familiar with the format of communication though social learning tools (e.g. Facebook, Twitter) and expect these to be replicated in the classroom. Academic staff are subsequently faced by potentially new learning environments, which adds to the complexity and pressures faced when teaching increasingly diverse students (Alvarez, Guasch, & Espasa, 2009; Hanson, 2009; Rienties, Beausaert, Grohnert, Niemantsverdriet, & Kommers, 2012; Volman, 2005).

In the context of European and US higher education, several researchers (Ebert-May et al., 2011; Löfström & Nevgi, 2008; Rienties, Brouwer, Lygo-Baker, & Townsend, 2011; Rienties et al., 2012) have suggested that higher education institutions (HEIs) should provide adequate professional development, training and staff support for academics in order to increase their awareness of the complex interplay between technology, pedagogy and the cognitive content in their disciplines. In particular, it is important that professional development is embedded into the academics' daily practice and not just concentrated upon in one particular context. In this way it is more likely that professional development has an impact on the beliefs of academics (Lawless & Pellegrino, 2007; Rienties, et al., 2011; Stes, De Maeyer, Gijbels, & Van Petegem, 2011; Stes, Min-Leliveld, Gijbels, & Van Petegem, 2010).

Research has shown that providing effective training for academics so that they learn how to effectively redesign learning opportunities (Ebert-May, et al., 2011; McCarney, 2004; Stes, et al., 2010), in particular through the incorporation of ICT (Alvarez, et al., 2009; Lawless & Pellegrino, 2007; Ziegenfuss & Lawler, 2008), is not straightforward. In a meta-review of 36 (primarily US) studies in higher education, Stes et al. (2010) conclude that only three (out of 31 studies) measured the impact of professional development on teachers' behaviour using a pre- and post-test method. So the challenge is not only designing effective, pedagogically sound professional development but also demonstrating the impact that this has had.

Both Lawless and Pellegrino (2007) and Stes et al. (2010) urge for more robust research of the effects of professional development and to move the focus of research on professional development from mere learning satisfaction of a particular training program to an understanding of whether academics actually learned something that was relevant, valuable and applicable to their daily practice. This reflects concerns in the literature that although professional development of academics in higher education may have begun at encouraging a greater focus on the learner (Asmar, 2002), the stimuli for this has been administration-led and not teacher-led (Hanson, 2009; Knapper, 2000) resulting in programs that reflect institutional goals rather than actually enhancing student learning. Furthermore, Stes et al. (2011) argue that it is important to conduct research into the characteristics of participants who volunteer to participate in professional development, as well as better understand why some academics successfully persist and complete such a program while others drop out.

Although an increasing number of HEIs in Australia, Europe and the US are experimenting with the provision of online teacher training (e.g. Prestridge, 2010; Renninger, Cai, Lewis, Adams, & Ernst, 2011), in a meta-review of blended and online teaching programs Alvarez et al. (2009) conclude that thus far no large-scale online teacher professionalization programs have been implemented or analysed. Therefore, in this paper we will investigate the impact of an innovative cross-institutional online professionalization program called MARCH^{ET} in the Netherlands. This program was delivered entirely online to 73 academics from eight HEIs. The program was specifically designed to enhance academics' skills by effectively integrating ICT into their teaching practice and to reflect on their academics' beliefs and intentions towards learning facilitation and knowledge transmission.

2. Technological Pedagogical Content Knowledge (TPACK)

In order to successfully implement ICT in education, a large body of research argues it is important to adjust the content of a module in line with the technology selected and the pedagogical approach used (Alvarez, et al., 2009; Lawless & Pellegrino, 2007; Rienties & Townsend, 2012; Ziegenfuss & Lawler, 2008). Mishra and Koehler (2006) designed the technological pedagogical content knowledge (TPACK) model with the aim of providing teachers with a conceptual model to effectively design and implement technology-enhanced learning. The TPACK model is based on the pedagogical content knowledge (PCK) model developed by Shulman (1986). In 2008 this was further improved to its current format (Koehler & Mishra, 2008), in which seven components are defined: (1) technological knowledge (TK), (2) content knowledge (CK), (3) pedagogical knowledge (PK), (4) pedagogical content knowledge (PCK), (5) technological content knowledge (TCK), (6) technological pedagogical knowledge (TPK), and (7) technological pedagogical content knowledge (TPACK). As illustrated in Figure 1, the TPACK model is framed by the type of knowledge teachers must acquire and develop in order to design a powerful and balanced technology-enhanced learning environment. Contexts such as level, discipline, institutional culture, or financial constraints have an important influence on the choices made by a teacher, which is represented by the circle around the model.

➔ Insert Figure 1 about here

Mishra and Koehler (2005, 2006) showed that learning was most effective when teachers have an awareness of the complex interplay between pedagogy, technology and discipline specific content knowledge. That is, in order to effectively address students' needs, teachers should have a sufficient combination of content knowledge, pedagogical knowledge and technological knowledge. For example, if a teacher decides to use a discussion forum to discuss various perspectives on the European crisis in a political science course without incorporating the technology into the course design (e.g. having a task were students have to search for the underlying perspectives of the EU governments and report this in the discussion forums), reconsidering the delivery of content (e.g. discussing EU decision-making processes in class) and/or readjusting the pedagogical approach (e.g. using a collaborative learning approach rather than using a traditional lecture-based approach), it is likely that the students will not actively use the discussion forums.

In practice there is often an imbalance between the technological, pedagogical and content knowledge of a teacher and how training available at individual institutions addresses these three key areas (Kinchin, 2012; Lawless & Pellegrino, 2007; Rienties & Townsend, 2012). Several researchers (McCarney, 2004; Mishra & Koehler, 2006; Rienties & Townsend, 2012; Ziegenfuss & Lawler, 2008) have shown that technological knowledge is often independent from content and pedagogical knowledge. Furthermore, research has suggested that content knowledge often determines the pedagogical approach taken and the adoption of particular technologies (Kinchin, 2012; Koehler & Mishra, 2005; Mishra & Koehler, 2006). For example, in a review of 118 remedial blended and online course designs, Rienties et al. (Rienties, Kaper, et al., 2012) found that teachers from 22 countries consistently aligned their content with their pedagogical approach. However, the use of technology in these 118 courses was not found to be correlated to the teachers' content or pedagogical approach. This reflects findings by Alvarez et al. (2009), who reviewed 16 blended and online teacher training programs and concluded that the link between the chosen technology and a teacher's pedagogical approach was limited.

Recently, several instruments (Abbitt, 2011; Chai, Koh, & Tsai, 2010; Lux, Bangert, & Whittier, 2011; Schmidt, Baran, Thompson, Koehler, & Mishra, 2009; Schmidt et al., 2009) have been developed to measure (perceived) TPACK knowledge and skills, primarily amongst pre-service teachers in primary and secondary education (for recent review, see Abbitt, 2011). For example, as one of the first instruments, Schmidt et al. (2009) developed a TPACK instrument for measuring pre-service teachers' self-assessment of the seven TPACK components, consisting of 75 items and explored the seven factor structure with 124 students in an instructional technology course in the US. In another, Lux et al. (2011) developed a 45-item TPACK instrument using six of the original seven TPACK factors, with the exception being technological content knowledge, to examine 120 pre-service teachers in an undergraduate educational technology course in the US. In a study amongst 889 pre-service teachers in Singapore using a shortened version of Schmidt et al. (2009), Chai et al. (2010) using regression analysis, found that technological knowledge, pedagogical knowledge and content knowledge were all significant predictors of pre-service teachers' TPACK, with pedagogical knowledge having the largest impact.

Although these findings amongst pre-service teachers are important steps towards validating and refining the TPACK model, limited research is available in a higher education context. The pressures on academic staff are substantially different from teachers in primary and secondary education (Alvarez, et al., 2009; Kinchin, 2012; Kinchin, Lygo-Baker, & Hay, 2008; Postareff, Lindblom-Ylänne, & Nevgi, 2007). As also argued in the next section, many academics primarily identify their own identity based upon their (research) discipline, and how pedagogy is used to deliver and share knowledge and skills with their students (Hanson, 2009; Lueddeke, 2003). In addition, higher education is characterised by a wide diversity of pedagogical approaches, with some academic staff having a student-centred approach, while others primarily adopt a teacher-centred approach (Kinchin, 2012; Lueddeke, 2003; Rienties, Kaper, et al., 2012). Furthermore, most academic staff engaged in our study already had substantial teaching experience. Finally, although most academic staff have already adopted some form of technology-enhanced learning using virtual learning environments (Kinchin, 2012;

Rienties & Townsend, 2012), there is a wide diversity in the amount and use of technology amongst higher education academics.

3. Teachers beliefs and intentions towards learning facilitation and knowledge transmission

It is believed that academics who have a more student-centred approach to teaching are more likely to achieve conceptual change amongst students, while academics who have a more teacher-centred approach to teaching are more likely to aim at the transmission of information and knowledge to students (Norton, Richardson, Hartley, Newstead, & Mayes, 2005; Postareff, et al., 2007; Prosser & Trigwell, 1999; Struyven, Dochy, & Janssens, 2011). Previous research in higher education has found that teachers adopting a more student-focussed approach to teaching are more likely to stimulate students to adopt a deep rather than a surface approach to their learning (Gow & Kember, 1993; Prosser & Trigwell, 1999).

Articulating the individual values or beliefs that an academic holds is challenging, but it is argued that these have a strong impact on how learning opportunities are designed and implemented (Kember & Gow, 1994). Based upon an inventory of 170 teaching staff, Gow and Kember (1993) distilled five conceptions of teaching that could be located on a continuum from a totally teacher-centred, content-orientated conception of teaching to a totally student-centred and learning-orientated conception of teaching. The full continuum reads: teaching as imparting information; teaching as transmitting structured knowledge; teaching as an interaction between the teacher and the student; teaching as facilitating understanding on the part of the student; and teaching as bringing about conceptual change and intellectual development in the student.

Norton et al. (2005) note that there is an apparent ambiguity in “approaches to teaching” used by Kember and Gow (1994), as teachers’ beliefs towards teaching are not necessarily the same as their intentions. In a review of literature on teachers' actions, beliefs and intentions, Norton et al. (2005) found that teachers have both "ideal" conceptions and "working" conceptions of teaching. Based upon an adjusted version of Gow and Kember's inventory to approaches to teaching, 556 respondents from four UK universities across three broad academic disciplines (arts, science and social science) were compared in relation to their beliefs and intentions (Norton, et al., 2005). Norton et al. (2005) applied a distinction between learning facilitation and knowledge transmission in beliefs and intentions of teachers, leading to 18 subscales. That is, within learning facilitation, two times five subscales are identified for beliefs and intentions, namely: problem solving, interactive education, supportive education, pastoral care, and motivating students. For knowledge transmission two times four factors are identified, namely: use of media, professional development for jobs, imparting information, and knowledge of subject.

Academics in this study were found to have significantly different beliefs and intentions, indicating that their own ideal conceptions of teaching differed from those played out in practice. Across the four institutions and three disciplinary areas, these academics had relatively similar beliefs towards teaching, but significantly differed in their intentions to teach. In particular, differences were found in the areas of interactive teaching, training for jobs and motivating students (Norton, et al., 2005). This implies that while academics express a similar belief of what good teaching should be their intentions of how to teach are substantially different.

Allowing academics to consider this complex interplay has been argued to be important. Norton et al. (2005) state that genuine development of academics' approaches to teaching comes from addressing their underlying conceptions of teaching and learning (Norton, et al., 2005; Prosser & Trigwell, 1999; Trigwell & Prosser, 2004). In a meta-review of the effects of 21 training programs, Lawless and Pellegrino (2007) found that effective training programs provide teachers with support for a substantial period of time, in order to allow teachers to reflect on their practice and allow them to implement the inputs from the training in their teaching and learning strategies. Ertmer (2005) argues that for lasting successful integration of technology in education it is necessary for the beliefs that teachers hold towards student-centred learning and technology in particular to be altered.

An increasing number of researchers have argued that formal training of teachers should be embedded in their daily practice, in particular when referring to the integration of technology into teaching (Lawless & Pellegrino, 2007; Löfström & Nevgi, 2008). However, to our knowledge and in line with Alvarez et al. (2009) only a limited number of studies have addressed how this integration of daily practice into formal teacher education can be effectively established. Much of the focus has been upon developing opportunities for conceptual change through some form of reflective practice (Young, 2008). So, rather than engaging directly with practice, teachers are asked to look at past actions and how these could be modified to enhance learning. Our interest was in considering whether a more reflexive approach, which enabled teachers to consider how and why they acted as they had would help to develop future practice. The approach sought to allow teachers to consider the intentions implied or enacted as they occurred in practice. In this way, it was hoped that the teachers could be encouraged to examine how their own beliefs were adapted or not in practice and what impact this had on the learning they were hoping to achieve.

3.1 Research questions

Based upon a theoretical framework, in our context of an online professional development program (see details in next section), we expected that academics who successfully completed the online training program would be more confident and able to balance technology and pedagogy into their discipline-specific teaching practice. In addition, given that the design of the training program had a substantial focus on collaborative (peer) and reflective learning, we expected that teachers' beliefs and intentions towards knowledge transmission would become less prominent in favour of stronger learning facilitation approaches. Finally, we expected that academics not completing the module would typically be those less interested in facilitation, and would have less experience with technology-enhanced learning. Therefore, in this explorative study the following research questions were formulated:

1. To what extent did academics learn to effectively implement ICT in their practice, as measured by an increase in (perceived) technological, pedagogical content knowledge (TPACK)?
2. To what extent did the professional training program lead to a change in teachers' beliefs and intentions (TBI) towards more student-centred learning?
3. To what extent did academics who successfully completed professional development differ from academics who dropped out in terms of TPACK and TBI?

4. Method

4.1 Setting

81 academics from nine HEIs in the Netherlands participated in a professional development program consisting of four separate online modules (i.e. collaborative knowledge building; web 2.0 educational applications; measuring knowledge and understanding; and supervising students in distance learning). First, the modules were designed based upon the notion that changing teaching practice takes time, in line with Lawless and Pellegrino (2007). Therefore, we designed

our modules to last for eight to twelve weeks, with sufficient autonomy and freedom for teachers to learn and reflect at a time of their convenience, with a total time investment of 20-25 hours.

Second, in line with Alvarez et al. (2009), we designed a program that allowed teachers to extend their socially situated competences in an active and meaningful learning environment. That is, teachers were distributed in small groups and discussed their teaching and learning challenges with peers from different institutions. The academics met online in classrooms using web-videoconferencing (See Figure 2) and were expected to attend four one-hour online videoconferences, once every two-three weeks. In between the online meetings, academics were expected to work on a range of assignments and to discuss their experiences in asynchronous discussion forums, similar to those described by Prestidge (2010). In this way, academics were able to learn from each others' experience, but at a time and place that was chosen by them, which aimed to allow for greater flexibility.

➔ Insert Figure 2 about here

Third, the modules were designed to improve the teaching practice of participating academics, rather than designing a training module on how to use technology X, Y or Z (Lawless & Pellegrino, 2007; McCarney, 2004). The goal for each academic taking part in the MARCH^{ET} was to implement the redesign of a teaching module in their own teaching practice within six months of finishing the training. The tasks and assignments were aligned to this overall goal (Alvarez, et al., 2009), and academics worked both individually and in groups, critically re-evaluating their teaching practice. After the program finished, academics were asked to implement the redesign into their daily teaching practice in order to test and further fine-tune their design. More specific details about the modules and design principles can be found elsewhere (Rienties et al., Submitted) or at www.marchet.nl

4.2 Participants

In order to guarantee anonymity of participants, we removed any reference to the respective institution a participant was working in. Furthermore, we removed participants who did not complete the pre-test of TPACK and TBI (see next section) or had too many missing values, leading to 73 participants. 68 participants were from the partner consortium of MARCH^{ET}, while five participants were from four other institutions. Given this relatively low number, in the remainder these five participants were grouped in an aggregate “other Institution”. Institution A and B are “typical” of eight traditional research-intensive universities in the Netherlands, which offer a wide range of disciplines. Institution C is one of the three technical research-intensive universities in the Netherlands, who specialise in engineering and technological science. Institution D is a representative HEI from one of the 24 universities of applied science. Finally, Institution E is a relatively new research-intensive university (established in the 70-ies), with a social and medical science focus and a specific emphasis on Problem-Based Learning.

The average age of the 73 participants was 41.90 (SD = 9.35) and 55% of the academics were male. The majority of participants (90%) were from the Netherlands, followed by Germany and Spain (both 2), Argentina, Belgium, Costa Rica, Turkey and the U.S (all represented by 1 participant). In total, 1 professor, 1 senior lecturer with a research role, 13 lecturers with a research role, 34 lecturers without a research role, 6 researchers without a teaching role, 5 PhD students, 1 manager and 12 other participants who do not fall uniquely in the previous categories participated. Academics from a wide range of disciplines participated in MARCH^{ET}. Participants who successfully passed the module were given a certificate, which could be used as evidence of their professional development.

4.3 Instruments

4.3.1 Measurement 1 Pre- and post-test TPACK

The TPACK questionnaire measures the participants' perceptions of how they designed and implemented technology-enhanced learning into their practice. At the time of implementing the research project, no TPACK questionnaires had been designed for a higher educational context. As indicated before, as the context of higher education is substantially different from pre-service teaching, and most participants already possessed substantial teaching experience and some knowledge of technology-enhanced learning, the focus of the questionnaire was shifted from the ability, knowledge and/or intentions to use technology (as in most TPACK questionnaires, e.g. Chai, et al., 2010; Schmidt, Baran, Thompson, Koehler, & Mishra, 2009) to the actual design and usage of technology-enhanced learning in the academics' practice.

Three experts in technology-enhanced learning with expertise in developing questionnaires designed a TPACK questionnaire consisting of 18 items, comprising six key elements: usage of technology-enhanced learning; expertise in teaching in collaborative learning settings; content and pedagogical knowledge; technological pedagogical knowledge; technological content knowledge, and TPACK. Given that participants were expected to fill in the TPACK and TBI questionnaire (see 4.3.2) twice (i.e. at the beginning and at the end of the module), a conscious choice was made by the research team to limit the number of items per scale and only use scales relevant for this study. That is why cognitive knowledge (CK) was left outside this study, cognitive pedagogical knowledge (CP) was shortened to one item, pedagogical knowledge (PK) was narrowed by focussing on expertise in teaching in collaborative learning settings and technological knowledge (TK) was replaced by usage of technology-enhanced learning. Finally, by aggregating the three TPACK categories and adding three additional items, an integrated TPACK score was derived. In Table 1 example items, the number of items per scale, and Cronbach alphas for the pre- and post-test are illustrated. All scales in pre- and post-test meet the threshold criteria commonly adopted in social science of Cronbach alpha ≥ .60, indicating reasonable reliability.

➔ Insert Table 1 about here

4.3.2 Measurement 2 Pre- and post-test Teachers' beliefs and intentions towards learning

In order to measure any change in student-centred vs. teacher-centred approaches made by academics following professional development, the Teacher Beliefs and Intentions (TBI) instrument of Norton et al. (2005) was used, as described above. A recent study by Owens (2011) amongst 561 academics in the UK using principal component analyses confirmed the TBI factor structures found by Norton et al. (2005). We adapted the Norton et al. (2005) instrument in two ways: first, questions on the use of media were replaced by more specific questions from the TPACK questionnaire (leading to 29 items); second, 12 items were phrased negatively, as Norton et al. (2005) indicated in their limitations that all their items were phrased positively, potentially leading to ceiling effects. As illustrated in Table 1, the Cronbach alphas of the four aggregated beliefs and intentions towards learning facilitation and knowledge transmission indicate a relatively poor reliability. Personal communication with Richardson (2012) indicated that he and his colleagues "were primarily focussed on the 18 individual subscales of the questionnaire rather than the four overall scales. Sixteen of the subscales were measured by two items each, and the other two subscales were measured by a single item”. Therefore, we conducted the pre- and post-test analyses both on the four aggregate beliefs and intentions as well as on the 16 subscales. Both instruments used a five-item Likert-response scale of 1 (totally disagree) to 5 (totally agree).

4.4 Data analysis

On the final day of the module, as part of the learning satisfaction questionnaire (results reported in Rienties et al (Submitted) the TPACK and TBI questionnaire was included as a post-test. Of the 40 (55%) participants who successfully completed the module, 33 participants filled in the post-test questionnaire, while only five out of 36 participants who dropped out completed the post-test questionnaire, despite two individualised email reminders and telephone calls. Given the limited number of responses from participants who dropped out, we calculated pre- and post-test results based upon the 33 participants who were successful. The metric that we used to estimate and describe the professional development effects were by taking the standardised difference of two means (Cohen’s d) effect size when paired sample-tests are significant at a 5% confidence level. This metric is appropriate when pre- and post-tests of the same sample are compared. Cohen’s d expresses the distance between two means in terms of their pooled standard deviation (Cohen, 1988). Cohen (1988) recommends that d= 0.20 (small effect), d=0.50 (moderate effect) and d=0.80 (large effect) serve as general guidelines across disciplines. Finally, for ANOVA analyses partial eta-squared ($\eta 2$) are calculated (Richardson, 2011), where .01 constitutes a small effect, .06 a medium and .14 a large effect.

5. Results

5.1 Effects of training in terms of Technology, Pedagogy and Content Knowledge

At the start of the training, taking a cut-off value of 3.0 for the TPACK instrument, 54% of the participants indicated that they did not actively use ICT in their teaching practice. Furthermore, 43% of the participants indicated limited expertise in designing and implementing collaborative learning environments. With respect to TPACK, participants were mostly positive about their cognitive pedagogical knowledge, and only 19% of the participants indicated that they did not balance cognition of their discipline with their pedagogical knowledge when designing and teaching a module. 30% of the participants indicated limited technological pedagogical knowledge, while 32% of the participants indicated limited technological content knowledge.

In Table 2, the technological pedagogical content knowledge (TPACK) of participants who passed the module and filled in both the pre- and post test before and after the training is illustrated. All TPACK scores for the post-test were higher than the pre-test, though only three were significant at a 5% confidence interval. That is, follow-up paired sample t-tests of the TPACK categories indicate that at the end of the program there was a significant increase in participants (who completed both pre- and post-test) using technology-enhanced learning in their daily practice and significantly more positive about their technological pedagogical knowledge on a 5% confidence interval, with a moderate effect size. Furthermore, the integrated TPACK score at the post-test was significantly higher than on the pre-test, with a moderate effect size. In other words, these findings indicate that participants were more inclined to use technology in their teaching and were confident about their abilities to balance and integrate technology within their pedagogical design and discipline after completing the program.

➔ Insert Table 2 about here

5.2 Effects of training on Teacher beliefs and intentions

In Table 3 the teacher beliefs and intentions towards learning facilitation and knowledge transmission measured at the beginning and end of the module are illustrated. Significant differences were found with respect to a decreased intention towards knowledge transmission, again by using paired sample t-tests, suggesting an intention to design modules less focussed on teacher-centred learning. However, our expectation that participants would therefore implement more student-centred learning was not supported in this study. Follow-up separate paired t-tests analyses (not illustrated) of the 18 scales found only significant differences in beliefs towards less knowledge transmission ($t = -3.231$, $p < 0.05$, d-value = 0.45) at the end of the program, as well as in intentions towards less knowledge transmission ($t = -2.126$, $p < 0.05$, d-value = 0.37). In sum, we conclude that academics did not become more student-centred as a result of the training, despite a decline in teachers beliefs towards knowledge transmission. However, we again caution readers to generalise these findings, given the relatively poor reliability scores of the TBI questionnaire in our context.

➔ Insert Table 3 about here

5.3 How do successful participants differ from unsuccessful participants?

In order to address the third and final question and address a main concern raised by Stes et al. (2011) that most research in professional development lacks robust analyses of the characteristics of participants who successfully complete such programmes, again using ANOVA analyses, we explored whether the 40 participants who successfully completed the module had different teacher beliefs and intentions or TPACK scores at the start of the training program than the 33 participants who failed, thus leading to a comparison amongst 73 participants. Neither the aggregate scores on learning facilitation and knowledge transmission, nor TPACK scores at the start of the MARCH[ET] differed significantly between those who completed the module and those who did not. Separate analyses of the 18 TBI scales (not illustrated) showed that academics who failed the course had significantly higher scores on beliefs towards training students for jobs ($F (1, 71) = 14.389$, $p < 0.05$, $\eta^2 = 0.17$) compared to participants who completed the program. Even when removing academics from the university of applied science Institution D, who are more directed towards teaching rather than research, these effects remain significant.

An additional noticeable difference appeared to be the amount of time invested in the module, for which we used a proxy based upon the time participants spent in the web-videoconference system. That is, participants who failed the module on average only spent 2:18 hours (SD = 2:03) attending and/or re-watching the web-videoconferencing sessions, while participants who successfully completed the module on average spent 4:59 hours (SD = 3.24) in Adobe Connect, which was significantly different ($F (1, 60) = 15.975$, $p < 0.05$, $\eta^2 = 0.21$) with a strong size effect.

One argument raised by Norton et al. (2005) and Land (2001) as to why teachers might differ in terms of completing training is the culture of the HEI and the particular discipline in which participants teach. Significant differences with strong effect sizes were found in passing rates across institutions ($F (5, 67) = 11.239$, $p < 0.05$, $\eta^2 = .456$). That is, the passing rates of the university of applied science Institution D (n = 14, 7%), the research-intensive Institution B (n = 18, 33%) and "Other Institution"(n = 5, 40%) were significantly below average, whereby n denotes the number of participants who started from the respective institution, while the percentage refers to the passing rate of those staff within the institution. At Institution A ($n = 12$, 75%), Institution E ($n = 17$, 94%), Institution C ($n = 5$, 100%) the number of successful participants were significantly higher.

Finally, significant differences were found in passing rates across disciplines ($F(9, 62) = 3.026$, $p < 0.05$, $\eta^2 = .305$), whereby academics from law ($n = 3$, 100%), science ($n= 16$, 88%), mathematics and statistics ($n = 6$, 83%), education ($n = 9$, 67%), and health ($n = 5$, 40%) successfully continued until the end of the module, while academics in ICT ($n = 4$, 33%), social science and business management ($n = 14$, 29%), and psychology ($n = 3$, 0%) were more likely to drop out. As not all disciplines had a sufficiently large sample size, one should be cautious of generalising these findings. However, they may indicate how different disciplines engage with the approach offered through the program.

Although we found some indication that the discipline as well as institution seem to impact upon the retention of participants on the online professional development program, no significant differences were found between participants with respect to their technological pedagogical content knowledge. Neither usage of technology-enhanced learning nor how academics align technology, pedagogy and content appeared to have influenced whether the 73 participants continued with the training program or not. A significant difference was found with respect to expertise in collaborative learning ($F(5, 67) = 4.644$, $p < 0.05$, $\eta^2 = .239$), which was a result of 17 academics from Institution E, which had adopted Problem-Based Learning as the core pedagogical framework for learning and teaching. As a result, all 17 academics from this institution had ample experience with collaborative learning, while in the other four institutions no specific pedagogical framework was prescribed.

6. Discussion and conclusion

Given the possibilities ICT offers to provide a rich learning experience to students, teachers need to be able to update their skills and expertise in a safe, powerful and cost-effective manner (Alvarez, et al., 2009; Smith, 2003). Although researchers (Lawless & Pellegrino, 2007; Löfström & Nevgi, 2008; Rienties, et al., 2011; Rienties, Kaper, et al., 2012; Rienties & Townsend, 2012) have suggested that HEIs should provide adequate professional development and support for teachers to acquire ICT and pedagogical skills, most studies that report on training have focussed on measuring learning satisfaction of such training programs, rather than addressing whether teachers have actually changed their beliefs and intentions towards student-centred learning and the use and integration of technology in practice. In line with recommendations by Lawless and Pellegrino (2007) and Stes et al. (2010), we used a pre-post design to measure the impact of an innovative online teacher training programme using Norton et al. (2005)'s Teacher Beliefs and Intentions towards learning questionnaire, as well as our own revised TPACK questionnaire.

A crucial point that we would like to emphasise is that for most academics the design of the online professionalization environment was completely different from any previous professionalization or training experience. In our opinion, this is one of the first studies that has tried to capture the impact of online professionalization programs for teachers (Alvarez, et al., 2009; Renninger, et al., 2011). Despite the innovative, perhaps radical design, results published elsewhere (Rienties, et al., Submitted) seem to indicate that most participating academics were very satisfied with the program. Given the rather unusual design, one might expect that academics with a stronger affinity towards technology would have been more inclined to continue, while others with greater anxiety (Hanson, 2009) would be more likely to drop out. Our findings seem to indicate a rather different picture, although more research of similar online professionalization programs in different contexts would need to replicate our initial findings before we can draw any significant claims for this.

With respect to the first research question, whether academics learned to effectively implement ICT in their practice, we found that all TPACK scores for the post-test were higher than the pre-test for those who completed the module. Usage of technology-enhanced learning, technological pedagogical knowledge and the overall TPACK score were significantly higher after academics had completed the program. These findings indicate that after twelve weeks of training participants were more confident in their ability to integrate technology within their pedagogical design and discipline and were putting this into practice. Although we did not conduct a fine-grained analysis to assess the impact of the redesigned modules, such as done by Ziegenfuss and Lawler (2008), a crucial barrier for some academics that limits engagement with ICT education is a lack of confidence in their own technological and pedagogical skills (Alvarez, et al., 2009; McCarney, 2004; Mishra & Koehler, 2005). The fact that the majority of academics in our context did enhance their confidence appears to have been a significant impact.

In contrast to our initial expectations, the professional training program did not lead to a change in teachers' beliefs and intentions towards more student-centred learning. Significant differences were found with respect to lower intentions towards knowledge transmission, indicating that participants were less convinced about the appropriateness of such a teaching style and wanted to redesign their module away from teacher-centred learning. However, Postareff et al. (2007) warns that triggering changes in teachers' attitudes towards student-centred learning takes time. They found through a longitudinal analysis of a range of face-to-face training programs in Finland that teachers participating in a short program of less than twelve weeks only marginally changed their attitudes towards teaching and learning.

Given that most of our participants had ten or more years experience in teaching, we are mindful that both Ertmer (2005) and Marsh (2007) found that changing (senior) teachers' attitudes towards student-centred learning is an even more difficult, long and cumbersome process. Additionally, at the start of our program the average score on beliefs and intentions towards learning facilitation were already substantially higher than knowledge transmission. Therefore, a potential "ceiling-effect" might be present for student-centredness. Finally, to affect the change explained here may require a shift in the underpinning values that help to define the actions an individual takes (Lygo-Baker, 2006). This is thought to be the most difficult change to facilitate and therefore during the relatively short period between the pre and post test the shift is unlikely to have had an opportunity to become recognisable to the participants.

Lastly, we found limited support for the notion that teachers who successfully completed the module were different in terms of their teacher beliefs and intentions towards learning or in their TPACK skills. This is an encouraging finding, as these results indicate that teachers could benefit from online training programs irrespective of whether they are more inclined towards student-centred or teacher-centred approaches. Furthermore, previous experience with technology did not appear to be related to engagement and whether individuals were likely or not to complete the program. The finding that those who were involved in training for jobs were more likely to drop out might have been a result of the design of the program, which was primarily focussed on helping teachers to challenge their underlying conceptions of teaching and learning and the role of technology and pedagogy in their daily practice. It is possible that teachers with a strong focus towards providing employability skills found the program somewhat abstract.

An interesting finding that deserves more exploration is that both disciplinary and institutional differences appeared to substantially influence whether participants successfully completed a module or not. One possible explanation for the extremely low passing rate of 7% at Institution D is that teachers in applied universities of science are more likely to already have substantial knowledge and expertise with pedagogical design and technology, as their roles are primarily focussed on teaching, providing pastoral care and administration. In contrast, most academics from the other four participating HEIs were from so-called research-intensive universities, where academic staff are primarily judged and promoted based on their research profile (Kinchin, et al., 2008). In particular, in more science-based institutions such as Institution A and Institution C, it is more common to use traditional teaching and learning approaches. Thus, the appeal of participating in an innovative, online collaborative training program that focuses on effective technology-integration for student-centred learning might be more appealing for research-intensive academics from “hard” sciences. Most academics from Institution B were medical specialists, who in contrast to most other participants not only have to conduct research and teach, but primarily provide patient care and services. As a result, with an extremely busy schedule, dropping a voluntary teacher training program would be quite logical when competing demands for time exist.

6.1 Limitations

A crucial limitation of our findings is that our measure of impact was based upon self-reported measurements of teachers’ beliefs and intentions towards learning facilitation and knowledge transmission (Stes, et al., 2010). A known problem with self-reported measurements is that participants who complete an intervention are in general more optimistic about their (perceived) change than those who failed to complete (Ebert-May, et al., 2011). Given that we did not randomise academics into a training or no-training condition, it is impossible to determine whether the academics would have changed even without teacher training.

A second limitation is that we did not measure whether academics were more effective in their daily teaching practice, that is, whether students were offered a more student-centred, engaging technology-enhanced learning experience. Preliminary findings in face-to-face professional development by Ebert-May et al. (2011) and Stes et al. (2011) seem to indicate that even if teachers are more positive about their (perceived) student-centred orientation and pedagogical skills, in practice students do not notice any difference. However, Marsh (2007) argues that teachers only change their teaching practice when they are critically thinking about their current practice. The challenge is often that without being supported to develop appropriate questions about practice, teachers do not know the options that there may be. This can be enhanced by developing an interdisciplinary approach (Peseta, Manathunga, & Jones, 2010) through which questions can be posed of practice within a particular frame by those who are outside of another participants' frame of reference. By putting academics from different disciplines and institutions together in an online environment in MARCH^{ET}, and by jointly redesigning and critically reflecting upon their module designs through this interdisciplinary approach, we think that a first step has been made for these academics to rethink and (re)consider how technology and pedagogy can be effectively integrated into their teaching practice.

A final limitation is the relatively poor reliability of the Teacher Beliefs and Intentions questionnaire developed by Norton et al. (2005). The purpose of the study of Norton et al. (2005) was not focussed on the aggregate four scales, rather their study was focussed on understanding the different beliefs and intentions towards the 18 subscales (Richardson, 2012). In a recent study by Owens (2011) amongst 561 university teachers, the same factor structures of beliefs and intentions towards learning facilitation and knowledge transmission of Norton et al. (2005) were found. Given the relatively limited sample size of our context, we were unable to conduct a confirmatory factor analysis as a minimum of 300 participants would be required. However, we encourage further research to confirm the reliability of the TBI. In particular, we encourage researchers to extend the number of items per subscale, as most subscales only had two items, or alternatively decrease the number of subscales but extend the number of items in order to develop a more robust, and easier to interpret, teacher beliefs instrument.

6.2 Practical implications

Although creating a shared online teacher professionalization program seems to be an excellent idea in these difficult economic times, and one wonders why more HEIs have not come up with this idea, several substantial barriers and (institutional) cultural differences had to be overcome before these modules were implemented. One recommendation for setting up a similar program would be to select a partnership of people across a consortium of universities that have already worked together in order to build on previous relationships. A second recommendation would be to use an online platform that is not related to a particular institution, in order to encourage a feeling of mutual ownership rather than "blaming" Institution X for a system that does not work or does not have tool X, Y or Z. A third recommendation, that worked really well in MARCH^{ET}, is to design an overall blue-print of the modules, but afterwards give the responsibilities of designing and implementing module A or B to two or three of the partner-institutions based upon their expertise within the consortium. In this way, modules can be designed relatively fast and may encourage HEIs to take responsibility for their respective module, replicating elements of collaborative learning. A fourth recommendation would be to allow teachers to share and reflect upon their experiences of their redesigned module with colleagues. For example, at the end of

MARCH^{ET} a conference was organised in order to bring various participants together to share their learning experiences, which participants found helpful in further fine-tuning their redesign. At the same time, by providing some practical perspectives of how teachers redesigned their technology-enhanced learning practice, we were able to encourage broader reflections on practice for other teachers.

All four modules are free to download and to be used freely, redesigned and reinvented for your own teacher training program or practice at www.marchet.nl. We encourage teacher educators to critically reflect on our design, and adjust this to the requirements of the local context, institution, and culture. We would very much welcome feedback on the application in different contexts.

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Figure 1: The TPACK model, from http://tpack.org

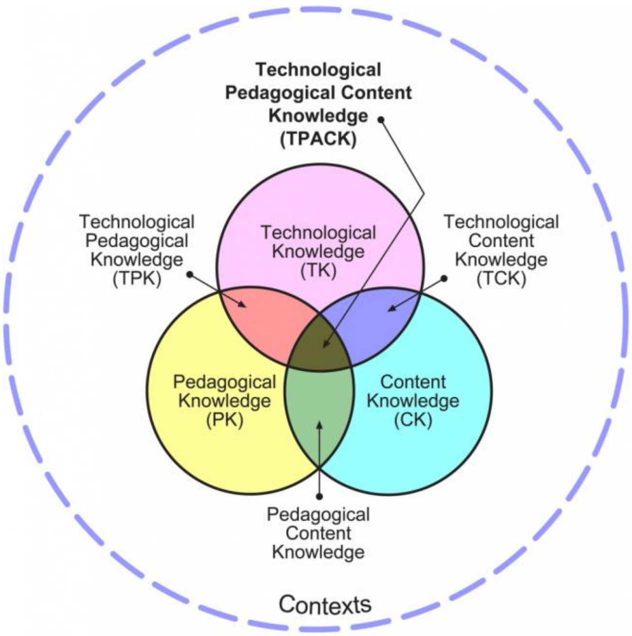

Figure 2: Screenshot of online videoconference of small group session.

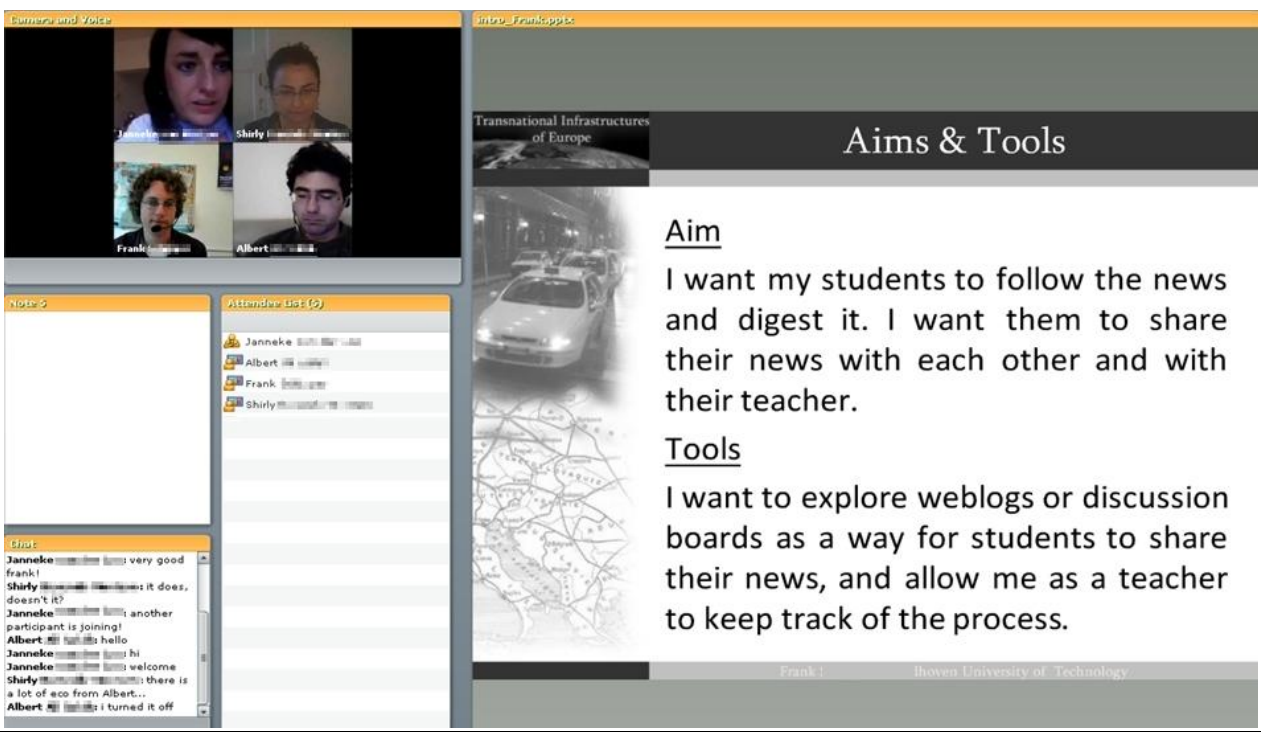

Table 1 TPACK and TBI example items and reliabilities

	Example item	Number of items	alpha pre-test	alpha post-test
TPACK				
Usage of technology-enhanced learning	In the courses I teach, ICT tools are used to facilitate learning in a group	3	.64	.71
Expertise in teaching in collaborative learning	I have experience in supporting students in collaborative learning	2	.68	.87
Content and pedagogical knowledge	When designing a teaching activity, I always consider how the content and the pedagogy influence each other	1	NA	NA
Technological pedagogical knowledge	When I design my teaching, I always consider how pedagogy will influence the use of technology (ICT tool)	4	.67	.70
Technological content knowledge	In my teaching I always consider how the technology (ICT tool) will influence the content of the teaching activity	3	.81	.64
TPACK	Designing teaching in which students use ICT requires changes in how we teach and what we teach	11	.77	.66
Teacher Beliefs and Intentions (Norton et al. 2005)				
Beliefs towards Learning facilitation	A good lecturer is one who recognises the personal needs of his/her students.	8	.61	.64
Beliefs towards Knowledge transmission	A good lecturer is one whose main role is to impart information to his/her students	6	.40	.57
Intentions towards Learning facilitation	In my lectures, I spend more time directing discussion than standing up and giving information.	9	.55	.61
Intentions towards Knowledge transmission	I try to pass on what information I know to the students	6	.41	.59

N Pre-test = 73, N Post-test = 36

Table 2 Pre and post-test of TPACK

	Pre-test		Post-test			Cohen d-value
	M	SD	M	SD	T-test	
Use of technology-enhanced learning	3.27	.90	3.52	.78	2.310*	.30
Expertise in teaching in collaborative learning	3.58	1.00	3.61	1.12	.229	.03
Content and pedagogical knowledge	4.06	.79	4.18	.85	.780	.15
Technological pedagogical knowledge	3.41	.77	3.70	.59	2.021*	.38
Technological content knowledge	3.48	.80	3.58	.72	0.950	.13
TPACK	3.54	.52	3.74	.37	2.387*	.38

Paired sample T-test (2-sided) (n = 33). *Coefficient is significant at the 0.05 level.

Table 3 Pre- and post test of teacher beliefs and intentions

	Pre-test		Post-test		T-test	Cohen d-value
	M	SD	M	SD		
Beliefs towards Learning facilitation	4.05	.44	4.02	.41	-.381	.07
Beliefs towards Knowledge transmission	3.56	.49	3.49	.49	-1.162	-.14
Intentions towards Learning facilitation	3.91	.36	3.95	.41	.771	.10
Intentions towards Knowledge transmission	3.80	.39	3.68	.37	-2.028*	-.32

Paired sample T-test (2-sided) (n = 33). *Coefficient is significant at the 0.05 level.