



## Online or offline – Does it matter?

### *A study of in-service teachers' perceptions of learning outcomes in Norway*

Cathrine Edelhard Tømte

*Professor, Department of Information Systems, University of Agder*  
[cathrine.tomte@uia.no](mailto:cathrine.tomte@uia.no)

Cay Gjerustad

*Senior Researcher, Nordic Institute for Studies in Innovation, Research and Education*

#### Abstract

Policymakers and scholars are scaling up online professional development programmes for teachers. We studied how in-service teachers in Norway perceived their learning outcomes for professional development programmes conducted either as campus-based or online courses. Based on survey data, we found teachers studying online and in campus-based settings have relatively similar perceptions of the learning outcomes. This changes when indicators of collaboration and support from teachers are controlled for, suggesting that these factors are more strongly related to learning outcomes for those in campus-based studies than those in online studies. Our findings contribute new insights on how perceived learning outcomes influence study formats and how social dimensions may impact professional development.

#### Keywords

professional development programmes, in-service teachers, study format, online learning, perceived learning outcome

Professional development programmes for teachers are an important means to prepare them for changes in schools and societies and to ensure quality in education. These programmes are delivered in various formats, including purely online formats and formats rooted in campus-based gatherings. In Norway, the Competence for Quality (CfQ) initiative serves as the main provider of professional development for in-service teachers.

As society's demands for professional development programmes for teachers are increasing (Darling-Hammond et al, 2017), various scalable online solutions, including Massive Online Open Courses (MOOCs), have been explored (Vivian, et al., 2014). These online professional development programmes are most likely to be formal courses offered by Higher Education Institutions (HEIs) and include regulations such as admission procedures and credits (Tømte et al., 2017a). Moreover, these programmes can be linked to overall initiatives such as “online teacher professional development”, or OTPD, which also includes informal online resources that may provide in-service teachers with professional development (Powell & Bodur, 2019).

Another aspect concerns how learning outcomes are perceived across various study formats. Studies that compare learning outcomes in online and campus-based programmes report little to no difference (Means et al. 2010; Bowen et al., 2012; Cavanaugh & Jacquemin, 2015; Eom, 2016; Rock, 2019). Moreover, better or poorer learning outcomes among students are circumstantial and context-dependent (Nortvig et al., 2018). Independent of study formats, circumstances such as (geographical) locations, learning community and student identity, course design and the educator's role all appear to influence students' learning satisfaction (Nortvig et al., 2018). Nonetheless, there has been limited coherence in the definitions of learning effectiveness and of "learning outcomes" (Noesgaard & Ørngreen, 2015). Studies on higher education define learning effectiveness as a "learning outcome", primarily measured as examination grades and completion rates. Studies on work-related learning apply a greater variety of definitions beyond learning outcomes, such as the application of learning to work contexts, organisational results and cost-effectiveness (Noesgaard & Ørngreen, 2015). Furthermore, the majority of such studies likely include regular students and regular study programmes, or adult students in workplace settings other than education. To the best of our knowledge, studies including in-service teachers or professional development programmes remain unexplored. Thus, we believe that studies that compare various study formats for in-service teachers' professional development programmes are limited in at least two ways: studies addressing the social dimension of professional development in study programmes, and of teachers' perceived learning outcomes, here understood as when participants report acquiring new understandings as a result of their participation in the professional learning programme. This definition, which is quite broad and inspired by Noesgaard and Ørngreen (2015), is further developed in the design and method section. Updated knowledge might inform the future design of new professional development programmes by addressing how such programmes can provide quality courses to their students (Bayar, 2014;) and how study formats may influence perceived learning outcomes for in-service teachers (Broadbent & Poon, 2015).

The current article meets these research gaps by addressing how in-service teachers perceive learning outcomes from formal professional development programmes, offered in online or campus-based instructional formats. The following research questions were posed:

How do collaboration and support influence in-service teachers' evaluations of their learning outcomes?

In what way does the study format affect in-service teachers' evaluations of their learning outcomes?

Our study is informed by survey data from monitoring the CfQ initiative in 2017.

## **Various study formats and professional development for in-service teachers**

Instructional modalities and formats, methods, and the ratio of online and campus-based instruction influence the overall learning design and expected learning outcomes (Moskal et al., 2013; Ching & Hursh, 2014). A systematic review demonstrated several positive outcomes linked to cooperation between teachers, such as skills enhancement at different levels for students, teachers and the school as an organisation (Vangrieken et al., 2015). Studies have also emphasised the importance of collaboration and cooperation between teachers in sharing and building knowledge in compulsory schools (Darling-Hammond et al., 2017). Collaborative interaction is highlighted to meet teachers' demands for "relevancy, authen-

ticity, usefulness, interaction and collaboration, reflection and context” (Powell & Bodur, 2019, 28). In addition, teachers need supervision and time to change their teaching, and studies recommend that teachers who pursue professional development would have to transfer knowledge from one context to another (Bayar, 2014).

Previous research suggests that comparing online or blended learning with conventional campus-based instruction is demanding and involves a number of aspects in addition to course format, such as differences in curriculum, pedagogical approach, learning time, course design and students’ previous experience (Means et al., 2010; Noesgaard & Ørngreen, 2015; Rock, 2019; Notvit et al., 2018; Powell & Bodur, 2019).

Researchers suggest that online students might have a number of advantages compared to students following classroom- or campus-based instruction that may add other influential aspects to the learning context beyond the instruction format (Means et al., 2010; Jaggars & Bailey, 2010; Bowen et al., 2012; Cavanaugh & Jacquemin, 2015; Eom, 2016).

Consequently, when studying these topics, it is crucial to address awareness towards differences in how various study formats might be interwoven with distinct contextual factors, and that there are limitations to such approaches. Nonetheless, studies that compare online and campus-based study formats might still serve as fruitful approaches to gain an insight into how these formats work, since such studies will at least provide new insights in overall trends regarding perceived learning experiences and outcomes (Rock, 2019).

We interpret these recommendations as a means of seeking more nuanced research designs for future studies. One way of narrowing down the scope is to look at study programmes within a certain knowledge domain or field, such as professional development programmes, and for certain target groups, such as in-service teachers. Vu et al. (2014) compared two groups of participants when studying in-service teachers’ participation in an online professional development programme, namely students with and without course completion. The study revealed that there were several factors that affected online learners’ success in online professional development programmes. Successful students were identified as those with self-discipline and a familiarity with technology. These findings are consistent with previous studies on online professional development programmes for other groups of participants, such as faculty staff within HEIs (Sun, 2014). An evaluation of an online early mathematics professional development programme for early childhood teachers demonstrated that their engagement in the programme positively impacted their attitudes, confidence, beliefs and knowledge in teaching early mathematics. (Sheridan & Wen, 2020). Moreover, a school administration’s expectations may influence the participation of in-service teachers in the professional development programme in the sense that those in-service teachers with clear expectations regarding their participation from their leaders were more likely to succeed, as long as they met the requirements of self-discipline and familiarity with technology (Vu et al., 2014).

The design of the learning environments varies across the different formats of learning (Nortvig et al., 2018; Philipsenet al., 2019). In online and blended contexts, support mechanisms may influence the way the students interact, but not how much they learn (Lantz-Andersson et al., 2018). Following this, their effectiveness is often questioned because student interaction in online discussion forums does not necessarily mean that students are actively engaged in the learning process (Burke & Fedorek, 2017). Perceived learning outcomes may thus serve as important indicators to map students’ learning, even if such indicators also have their limitations, e.g. such self-reports do not provide us with information on how learning outcomes are translated into new practices or behaviours.

## Communities of practice as professional development

When studying professional development programmes for teachers, it is necessary to address the underlying purposes of, or premises about, teaching and teacher learning since these purposes might influence the overall perspective on learning that seems to dominate many professional development programmes for teachers: a socio-cultural learning perspective, deriving from Vygotsky (1976), Lave and Wenger (1991) and Säljö (2000). Here, learning is understood as a social process in which communication and collaboration are crucial. Lave and Wenger suggest that learning takes place in distinct contexts, framed as “situated learning” (Lave & Wenger, 1991; Wenger, 1998). Following this, Lave and Wenger suggest that situated learning works best when learners share the same contexts as a point of departure for discussion and reflection; they term this shared arena the “communities of practice”.

Communities of practice are highly relevant when looking at study designs of professional development courses for teachers. In this way, teachers are given the opportunity to develop their professional knowledge through cooperation and reflection with their peers (Tseng & Kuo, 2014; Ching & Hursh, 2014; Lantz-Andersson et al., 2018; Powell & Bodur, 2019).

## The professional developmental landscape for teachers in Norway

The Competence for Quality (CfQ) initiative was established in 2009 to strengthen the competence of Norwegian teachers and school leaders (Ministry of Education, 2011), and has provided considerable resources to ensure the nationwide availability of professional development programmes for teachers.

The CfQ scheme has been monitored by researchers since 2011 to explore students’ perceptions of the quality of the CfQ programmes, their learning outcomes and their overall evaluation of the initiative. In 2017, the survey linked to the CfQ initiative included questions on the format of participation, that is, whether students participated in campus-based gatherings or in purely online study formats. These new data allow us to look at whether their perceptions of the programme in which they participate differ when linked to their format of participation, e.g. types of collaboration and communication. In other words, in this article we aim to investigate these data in order to reveal if there are any differences in how students evaluate their programme based on their offline or online participation.

The CfQ initiative invites HEIs to develop professional development programmes for in-service teachers by offering funding. To secure funding, the programmes have to include overall requirements on pedagogical principles independent of study formats outlined by the government. While the CfQ initiative includes many subject areas, a considerable number of HEIs offer professional development programmes in mathematics. This is due to the fact that the government has earmarked extra funding resources to the improvement of the competence of in-service teachers in mathematics. HEIs may thus apply for additional funding to develop programmes in mathematics. There are two types of mathematics programmes, framed as either 1 or 2. The latter is more advanced than the former, and requires prior knowledge of the subject. In 2017, around 15 HEIs offered 46 programmes in Mathematics 1 and 2, which means that this subject area is prioritised by a considerable number of HEIs. Around 23 of these programmes were Mathematics 2 (Ulriksen & Gjerustad, 2017). In the same year, a large-scale purely online professional development programme in Mathematics 1 was launched with around 280 in-service teachers as participants. The pro-

gramme was monitored by researchers, and one key finding was that these students reported being satisfied with their learning outcomes and that the programme was also considered successful in terms of course completion; around 80% completed the programme and obtained their 30 ECTS (Tømte et al., 2017b). Since this professional development programme is part of the CfQ scheme, some of its in-service teachers are included as respondents to the CfQ survey, which comprises the empirical section of the present article. Participants from this programme are thus included in the respondent group reporting their participation in purely online professional development programmes. However, this respondent group does not solely derive from this large-scale online professional development programme, but also includes participants from similar programmes.

## Design and method

The article draws on a research design which includes survey data from the monitoring of the CfQ initiative in 2017 and aims to link the findings to the research literature on professional development for teachers with a focus on studies addressing variations across study formats.

The survey was sent to all teachers (N=5851) participating in professional development within the CfQ initiative in the school year 2016–17. Some teachers (N=234) were not reached due to incorrect email addresses. Ultimately, 5617 teachers received the survey, of whom 57% answered (Ulriksen & Gjerustad, 2017). The analysis in this article is based on a sub-sample consisting of teachers in mathematics courses. The survey was sent to all 1810 teachers studying mathematics within the CfQ initiative, and 906 (51%) answered. Eleven participants were excluded from the analysis because they took more than one course, which could mean that they studied both online and offline. In addition, 137 recipients could not be included in the analysis since they had not answered all the necessary questions. Therefore, the analyses was conducted on 758 participants, 42% of those studying mathematics. The low participation rate suggests that the data should not be considered representative. However, the data provide a valuable insight into teachers' perceptions of different modes of professional development.

The survey was administered in May 2017. This means that the teachers had been enrolled in the professional development programmes for around 9 months, which provided them with several months of experience when answering the survey.

## Variables

*Dependent variable:* Perceived learning outcome. The dependent variable of the study, perceived learning outcomes, is the average score on the following five items:

- The professional development has been a starting point for reflection on own practice
- The professional development has made me more engaged in my work
- The professional development has improved my teaching in general
- The professional development has led to improved academic achievements for my students
- The professional development has given me ideas on how to teach more practically

Responses were given on a six-point Likert scale, with higher scores indicating better learning outcomes. Cronbach's alpha for the scale is 0.93. This implies that the five items are closely related measures of the same construct. The instrument has been developed through

testing and revision across several years. In regard to the independent variables, information from a question regarding the number of gatherings in the study was used to create a dichotomous variable indicating whether the study they attended was purely online or not. Information about the type of course was used to indicate the level of the course and at what grades the courses were directed. Two variables were used as indicators of collaboration with fellow students and the support from those teaching the course. Answers were given on a scale from 1 (totally disagree) to 6 (totally agree), with a higher score indicating greater collaboration and support. A dichotomous variable was used as an indicator of whether the respondent studied together with colleagues from the same school or not. In addition, gender, years working as teacher, length of general education, previous ECTS in mathematics, whether the respondents worked in primary, lower- or upper-secondary school, satisfaction with how the working environment facilitated their studies, and reasons for studying were included as control variables. All variables included in the analysis are presented in Tables 1 and 2. To examine possible differences between students in campus-based and online studies, distribution and mean scores are presented individually for the two study formats. Differences are significance-tested using t-tests.

Linear regression was used to examine the relationship between studying online and perceived learning outcomes. This method was chosen because it is particularly relevant for examining the relationship between several independent control variables and one dependent variable (Cohen et al., 2003).

## Findings

Tables 1 and 2 show differences between teachers in online and campus-based studies on the variables used in the analysis. Table 1 shows that there are some differences between teachers in online versus campus-based studies. This is particularly evident for the type of mathematics course, the school level at which they work, and sufficient support from those who teach. This indicates that the two groups vary on these variables. Teachers studying online more often work in primary school, and more frequently attend level 1 courses aimed at the 1st to 7th grades, whereas those in campus-based studies tend to work in lower- and upper-secondary schools and attend level 2 courses for the 5th to 10th grade. In addition, teachers in campus-based studies are more likely to agree that they have received sufficient support from course instructors. In the regression analysis, these differences are controlled for.

Table 2 shows significant differences between the two groups in regard to “Benefitted from collaboration with fellow students” and “Sufficient support from those who taught”. Those in campus-based studies report that they benefitted more from collaboration and more often experienced sufficient support than those in online studies. The dependent variable is somewhat negatively skewed (median is larger than mean), but the skewness is within what is considered acceptable (Bulmer, 1979).

**Table 1** Differences between teachers in online and campus bases studies. Categorical variables. N = 758.

Variable	Category	Online %	Campus-based %
Study format	Online/Campus based	24.8	75.2
Type of Mathematics course	Level 1, grade 1st – 7th***	65.4	35.7
	Level 1, grade 5th–10th	16.5	18.2
	Level 1, grade 8th – 13th***	0.5	8.8
	Level 2, grade 1st –7th	9	6.3
	Level 2, grade 5th–10th***	7.4	23.6
	Level 2, grade 8th–3th***	1.1	7.4
Gender	Female*	72.3	65.8
	Male*	27.7	34.2
Working experience	0–10 years**	21.8	32.6
	11–20 years	46.3	48.3
	21–30 years***	28.2	15.6
	More than 30 years	3.7	3.5
Working at school level	Primary***	79.3	50.6
	Lower secondary***	19.1	35.2
	Upper secondary***	1.6	13.8
	Adult education	0	0.4
Education	Short tertiary	18.6	23.1
	Long tertiary	81.4	76.9
Reason for studying	New competence requirements made it necessary***	49.5	35.2
	Interested in learning more about the subject**	33	42.6
	Because I teach a subject where I have little competence	6.9	10
	I wanted to teach a new subject**	2.7	7.4
	Because the headmaster wanted it	3.7	1.9
	I want to qualify for another position	2.7	1.9
	Other	1.6	1.1
Financial arrangement	Scholarship***	26.6	11.9
	Substitute arrangement***	73.4	88.1
Studying with colleagues	Yes	71.1	71.3
	No	28.9	28.7

\*p &lt; .05 \*\*p &lt; .01 \*\*\*p &lt; .001.

**Table 2** Differences between teachers in online and campus bases studies. Continuing variables. N = 758.

Variable	Online		Campus-based		Range	
	Mean	Std.dev.	Mean	Std.dev.	Min.	Max.
Perceived learning outcomes	4.62	1.24	4.50	1.27	1	6
Number of ECTS in study	29.68	4.90	29.71	3.68	0	60
Facilitation for studies	4.12	0.92	4.06	0.89	1	5
Benefitted from collaboration with fellow students***	3.35	1.72	4.75	1.49	1	6
Sufficient support from those who taught***	3.67	1.59	4.36	1.32	1	6

\*p < .05 \*\*p < .01 \*\*\*p < .001.

The results of the regression analyses are presented in Table 3. The table shows that in Model 1, where only type of course is controlled for, there is no significant relationship between studying online, or not, and the perceived learning outcome. Teachers studying mathematics online report the same learning outcome as those in campus-based studies.

The relationship between study format and perceived learning outcomes is not significantly altered in Model 2, where background factors, financial arrangement and facilitation for the study are controlled for.

Finally, in Model 3, where indicators of studying with colleagues, collaboration and support in the study are controlled for, the relationship between study format and perceived learning outcomes changes. In this model there is a positive relationship between studying online and perceived learning outcomes. The change indicates that collaboration and support in the study is more strongly related to perceived learning outcomes for those in campus-based studies than those in online studies. When these variables are controlled for, the relationship between study format and learning outcomes is altered. There is a substantial increase in R<sup>2</sup> from Model 2 to Model 3, suggesting that collaboration and support together explain 18% of the variation in perceived learning outcomes.

To test for interaction between the number of gatherings on the one hand, and support, collaboration and facilitation on the other, interaction analysis was conducted. The interactions were not significant (all p > .05).

**Table 3** Linear regression with perceived learning outcomes as a dependent variable. In Model 1, type of course were controlled for. In Model 2, indicators of individual background, reasons for studying, financial arrangement and facilitation were added. In Model 3, indicators of collaboration and support were added. N = 758.

	Model 1		Model 2		Model 3	
	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.
<b>Study format</b> (Ref: Online)						
Campus based	0.17	0.11	0.10	0.11	-0.29**	0.10
<b>Type of Mathematics course</b> (Ref: Level 1, 1.-7.)						
Level 1, 5.-10.	-0.56***	0.12	-0.63***	0.16	-0.56***	0.15
Level 1, 8.-13.	-1.00***	0.18	-1.37***	0.28	-1.41***	0.25
Level 2, 1.-7.	0.37*	0.18	0.29	0.19	0.09	0.17



	Model 1		Model 2		Model 3	
	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.
Level 2, 5.–10.	-0.84***	0.12	-0.94***	0.18	-0.76***	0.16
Level 2, 8.–13.	-0.90***	0.20	-1.25***	0.28	-1.20***	0.25
<b>Gender</b> (Ref: Female)						
Male			-0.13	0.10	-0.09	0.09
<b>Number of ECTS in topic</b>			0.01	0.01	0.00	0.01
<b>Working experience</b> (Ref: 0–10 years)						
11–20 years			-0.08	0.11	-0.05	0.10
21–30 years			-0.13	0.13	-0.07	0.12
More than 30 years			0.23	0.24	0.37	0.22
<b>Working at level</b> (Ref: Primary school)						
Lower secondary			0.26	0.15	0.15	0.13
Upper secondary			0.50*	0.24	0.39	0.22
Adult education			1.05	0.84	0.29	0.75
<b>Education</b> (Ref: Short tertiary)						
Long tertiary			0.07	0.11	0.11	0.09
<b>ECTS in mathematics before continuing education</b> (Ref: 0)						
1–15			0.06	0.13	0.09	0.12
16–30			-0.09	0.15	-0.07	0.13
More than 30			0.08	0.15	0.08	0.13
<b>Reason for studying</b> (Ref: New competence requirements made it necessary)						
Interested about learning more about the subject			0.47***	0.10	0.32***	0.09
Because I teach a subject where I have little competence			0.44**	0.16	0.35*	0.15
I wanted to teach a new subject			0.03	0.20	0.17	0.18
Because the headmaster wanted it			0.08	0.29	0.24	0.26
I want to qualify for another position			-0.06	0.31	-0.14	0.27
Other			-0.34	0.40	-0.52	0.36
<b>Financial arrangement</b> (Ref: Scholarship)						
Substitute arrangement			0.00	0.12	-0.02	0.11
<b>Facilitation for studies</b>			0.16***	0.05	0.10*	0.04
<b>Studying with colleagues</b>					-0.05	0.09
<b>Benefitted from collaboration with fellow students</b>					0.13***	0.03
<b>Sufficient support from those who taught</b>					0.33***	0.03
Constant	4.58	0.18	3.66	0.58	2.62	0.53
Adjusted R <sup>2</sup>	0.10		0.14		0.32	

\*p < .05 \*\*p < .01 \*\*\*p < .001.

Overall, the analysis indicates that teachers studying online and in campus-based settings have relatively similar perceptions of the learning outcomes. This result changes when indicators of collaboration and support from teachers are controlled for, suggesting that these factors are more strongly related to learning outcomes for those in campus-based studies than those in online studies.

Finally, the analysis shows that several variables predict learning outcomes, such as type of mathematics course and reason for studying.

## **Online and campus-based communities of practices**

In this section we discuss the findings and how they relate to the research questions introduced at the start of the article. The first question was: “How do collaboration and support influence in-service teachers’ evaluations of their learning outcomes?”. Our theoretical lens suggested learning as a social and dialogue-based process in which communities of practices are shaped for knowledge development (Lave & Wenger, 1991; Wenger, 1998). In line with this, teachers who participate in professional development programmes are given the opportunity to develop their professional knowledge through cooperation with their peers and with support from faculty staff from the HEIs offering the professional development programme. The analysis revealed that in-service teachers who participated in campus-based professional development programmes reported higher levels of collaboration and support than teachers in online programmes. We may interpret this finding as meaning that in-service teachers with campus-based gatherings had opportunities to discuss and exchange ideas about their learning process, the course content and other aspects related to their actual professional development programme when meeting up with their peers and instructors. They might also consider the campus gatherings as arenas to express a diverse range of emotions, such as frustration or joy linked to their learning (see, for example, Isohätälä et al., 2019). Moreover, teachers also had the opportunity to keep in touch and continue their collaboration and communication with peers and faculty staff independent of the gatherings.

If we follow the line of argument from a socio-cultural learning perspective, one preliminary assumption would be that the in-service teachers participating in professional development programmes with many campus-based gatherings would report a higher level of perceived learning outcomes, since these gatherings provide opportunities for collaboration and support to a greater extent than courses which take place purely online. That said, our second research question sheds light on whether the study format had any influence regarding the in-service teachers’ perceived learning outcomes: “In what way do in-service teachers participating in a professional development programme on mathematics evaluate their programme in terms of perceived learning outcomes?”

Our research context showed that the professional education programmes for in-service teachers provided by the Norwegian government within the CfQ scheme were to follow a set of required pedagogical principles regardless of content and study format. In our case, this means that the online and campus-based programmes in mathematics share a set of common pedagogical principles, in addition to content.

Our findings thus both confirm and contrast previous studies which compared study formats and perceived learning outcomes (Means et al., 2010; Cavanaugh & Jacquemin, 2015; Nortvig et al., 2018). We also found similar perceptions on learning outcomes regardless of study formats. Moreover, the studies recommended the integration of other dimensions in future study designs, such as curricula, student background, subject matter, learn-

ing communities and educator's role. As demonstrated, our study has integrated several of these dimensions. Even if collaboration and support are identified as important to students' learning, we do not know if the types of collaboration and support that in-service teachers report are integrated parts of the study design, such as mandatory assignments, or just voluntary group work that emerges accidentally as students meet face-to-face at the gatherings. Previous studies have identified that the type of collaboration and its status as mandatory or voluntary might influence students' learning outcomes (Shaw, 2011; Prøytz & Nerland, 2018). For example, when collaboration is part of the study design and even becomes part of the assignments, it may have a positive impact on students' learning outcomes. In contrast, if collaboration with peers is simply enhanced but not integrated as a mandatory part of the study design, the value of the collaboration in terms of learning outcomes may be more unpredictable and coincidental (Prøytz & Nerland, 2018). Moreover, collaboration and support may also be integrated into purely online study formats, and may be voluntary or mandatory, just as in the case of campus-based gatherings (Tømte et al., 2017b). The actual study design of the online programme should integrate forms of mandatory assignments for dialogue in online situations, since it cannot be expected that all course participants want to take part in group discussions or answer questions online, even if they are encouraged to do so (Shearer, 2009). Assignments may serve as fruitful approaches in these contexts.

When studying successful and unsuccessful participation of in-service teachers in online professional development programmes, Vu et al. (2014) observed that the expectations of the local school administration influenced participation in the sense that in-service teachers with clear ideas of their leaders' or administration's expectations regarding their participation were more likely to succeed, as long as they met the requirements of self-discipline and familiarity with technology. In the context of the in-service teachers participating in the CfQ scheme, one could assume that these students recognised similar expectations held by their local school administrations, since such expectations serve as a kind of rationale behind their participation in a professional development programme. In-service teachers have to apply to their school principals in order to request permission to participate in the CfQ scheme, and it is the principals who present the first selection of applicants to the municipality, which, together with the governmental agency, proceeds with the applications to the HEIs. In this context, the overall expectation of the learning outcome held by the local school administration and its leaders may influence the perceived learning outcomes of the in-service teachers in continuing education. Another possible reason for successful participation may be linked to the subject matter. Augmenting the number of in-service teachers with formal qualifications in mathematics has been on the political agenda in recent years, and, within the CfQ scheme, mathematics has been a prioritised subject area. Following this, in-service teachers without qualifications in this subject area are expected to apply for professional education programmes so that they can meet the future requirements of their position. As demonstrated in this study, there are a considerable number of students working as teachers in grades 1 to 7, which is a competence area that most schools need to strengthen. Schools may thus consider it as an efficient way to strengthen this competence by enrolling several teachers in online versions of these professional development programmes. This motivation may also correspond with the idea that societal expectations related to formal requirements in mathematics may also have influenced the students' motivation to successfully complete their course, as well as influencing their perceived learning outcomes from the professional development programme. Another motivation for selecting online programmes might relate to geographical dimensions. Not all students live near

a HEI that offers campus-based programmes, and their ability to attend professional educational programmes might thus be restricted to attending purely online offerings. While our theoretical approach suggested that professional development for teachers as communities of practices based on collaboration and support impact perceived learning outcomes, our study has demonstrated that there are several additional variables that predict learning outcomes.

## Limitations and future research

In this article we have looked at in-service teachers and their perceived learning outcomes, and how this relates to collaboration and study formats. While this scope is narrow, it is also new in the sense that few studies have addressed this issue. Still, there are some limitations to our study. First, we do not have sufficient data regarding how the in-service teachers participating in the professional development programme collaborated with peers from their own school, or with colleagues from other schools. If we turn to another study on participants in a large-scale online professional programme for in-service teachers in mathematics (Tømte et al., 2017b), most in-service teachers were the sole participants from their school, and they reported considerable perceived learning outcomes. This study design included mandatory peer reviews and other assignments that demanded collaboration with peers online, such as comments and contributions to online discussion boards.

Another limitation relates to participants' selection of study format. As previously mentioned, there might be several reasons for students to choose either a campus-based or online study format: while some students prefer the flexibility that comes with online solutions, others might prefer to meet up with peers at gatherings. This self-selection of study format might influence students' learning outcomes in that they were satisfied with the study format they preferred for participation. Demographic dimensions might also influence their choices: If they live in remote areas, they might have no other option other than a purely online format when choosing to attend a professional development programme. It might also be the case that their headmaster told them to participate in distinct courses, which might or might not have resonated with their learning format preferences. Our data only provide limited information on these matters. Our study includes self-reported estimations of learning outcomes, which are subjective measurements, and have to be interpreted with care. The study would also have benefitted from information on the teachers' experience in the use of ICT, as this could be related to their perceived learning outcome from online studies. In addition, data that would allow to control for school/intervention fixed effects would have been positive.

Another limitation might be the study's narrow scope, as it covers only one knowledge domain—mathematics. Even if this subject is flagged as important by the government, and it is envisioned that teachers in Norway will choose this distinct subject when applying for professional development programmes, we do not know whether we would have obtained similar outcomes if we had studied other subject areas in professional development programmes. This might be an interesting avenue for future research. Moreover, the present study looks at perceived learning outcomes and does not measure any tangible impact other than self-reports from the participants. Still, these reports are valuable since they represent the learning experiences of the participants. Our study also has theoretical implications since it demonstrates that several variables other than collaboration and support predict learning outcomes.

## Conclusion

In this study we posed two research questions: “How do collaboration and support influence in-service teachers’ evaluations of their learning outcomes?” and, “In what way does the study format affect in-service teachers’ evaluations of their learning outcomes?”. The questions were explored through quantitative analysis of a sub-sample from a survey sent to teachers participating in professional development programmes in Norway. One key finding was that teachers who participated in professional development programmes with campus-based gatherings reported a high level of collaboration and support. However, when comparing these students with students who participated in purely online professional development programmes, we found that the latter group of students reported a higher degree of perceived learning outcomes. These findings demand further research. For example, researchers should design studies which include follow-up studies taking place a while after the students have finished their professional development programmes. With such a design, we might obtain more tangible information on whether the teachers changed their teaching methods following the course, and link this to their experiences from the professional education programme in which they participated. One implication of this study could be that HEIs may reconsider how they organise their professional development programmes in the future. Our study, although small, nuances perspectives on the social dimension of learning when comparing various study formats which might be of interest to the ongoing international debate on scaling up online professional development programmes for teachers, such as MOOCs and similar offerings.

*Acknowledgements: We are grateful to NIFU for funding initial work that resulted in this article.*

## References

- Bayar, A. (2014). The Components of Effective Professional Development Activities in terms of Teachers’ Perspective. *International Online Journal of Educational Sciences*, 6, 319–327.
- Bowen, W., Lack, K., Chingos, M., & Nygren, T. (2015). *Interactive Learning Online at Public Universities: Evidence from Randomized Trials*. Ithaca S+R. <https://doi.org/10.18665/sr.22464>
- Broadbent, J., & Poon, W. L. (2015). Self-regulated learning strategies & academic achievement in online higher education learning environments: A systematic review. *The Internet and Higher Education*, 27, 1–13. <https://doi.org/10.1016/j.iheduc.2015.04.007>
- Bulmer, M. G. (1979). *Principles of statistics*. Dover Publications Inc.
- Burke, A. S., & Fedorek, B. (2017). Does “flipping” promote engagement?: A comparison of a traditional, online, and flipped class. *Active Learning in Higher Education*, 18(1), 11–24. <https://doi.org/10.1177/1469787417693487>
- Cavanaugh, J., & Jacquemin, S. J. (2015). A Large Sample Comparison of Grade Based Student Learning Outcomes in Online vs. Face-to-Face Courses. *Online Learning*, 19(2). <https://doi.org/10.24059/olj.v19i2.454>
- Ching, C. C., & Hursh, A. W. (2014). Peer modeling and innovation adoption among teachers in online professional development. *Computers & Education*, 73, 72–82. <https://doi.org/10.1016/j.compedu.2013.12.011>
- Cohen, J., Cohen, C., West, S.G., & Aiken, L.S. *Applied multiple regression/Correlation analysis for the behavioral sciences*. Lawrence Erlbaum Associates, Publishers.
- Darling-Hammond, L., Hyler, M. E. & Gardner, M. (2017) *Effective teacher professional development*. Learning Policy Institute
- Isohätälä, J., Näykki, P., & Järvelä, S. (2020). Cognitive and Socio-Emotional Interaction in Collaborative Learning: Exploring Fluctuations in Students’ Participation. *Scandinavian Journal of Educational Research*, 64(6), 831–851. <https://doi.org/10.1080/00313831.2019.1623310>

- Jaggars, S., & Bailey, T. R. (2010). Effectiveness of fully online courses for college students: Response to a Department of Education meta-analysis. Columbia University Academic Commons.
- Lantz-Andersson, A., Lundin, M., & Selwyn, N. (2018). Twenty years of online teacher communities: A systematic review of formally-organized and informally-developed professional learning groups. *Teaching and Teacher Education*, 75, 302–315. <https://doi.org/10.1016/j.tate.2018.07.008>
- Lave, J. & Wenger E. (1991). *Situated learning: Legitimate peripheral participation*. England: Cambridge University Press.
- Means, B., Toymana, Y., Murphy, R., Bakia, M., & Jones, K. (2010). Evaluation of evidence-based practices in online learning: A meta-analysis and review of online learning studies. *U.S. Department of Education*.
- Moskal, P., Dziuban, C., & Hartman, J. (2013). Blended learning: A dangerous idea? *The Internet and Higher Education*, 18, 15–23. <https://doi.org/10.1016/j.iheduc.2012.12.001>
- Nerland, M. & Prøytz, T. (2017). *Pathways to quality in higher education: Case studies of educational practices in eight courses*. Nordic Institute for Studies in Innovation, Research and Education (NIFU).
- Noesgaard S. S. & Ørngreen R. (2015) The Effectiveness of E-Learning: An Explorative and Integrative Review of the Definitions, Methodologies and Factors that Promote e-Learning Effectiveness *The Electronic Journal of eLearning Volume 13 (4)* 278–290.
- Nortvig, A. M., Petersen, A. K. & Balle, S. H., (2018). A Literature Review of the Factors Influencing ELearning and Blended Learning in Relation to Learning Outcome, Student Satisfaction and Engagement. *The Electronic Journal of e-Learning*, 16(1), . 46–55.
- Philipsen, B., Tondeur, J., Pareja Roblin, N. et al. (2019) Improving teacher professional development for online and blended learning: a systematic meta-aggregative review. *Educational Technology Research and Development* (2019) 1–30. <https://doi.org/10.1007/s11423-019-09645-8>
- Powell, C. G. & Budur, Y. (2019) Teachers' perceptions of an online professional development experience: Implications for a design and implementation framework. *Teaching and Teacher Education* 77 (2019) 19–30. <https://doi.org/10.1016/j.tate.2018.09.004>
- Rock, H., M. (2019). A Framework for Effective Online Professional Development. In M. Boboc, & S. Koç (Eds.), *Student-Centred Virtual Learning Environments in Higher Education* 210–232). IGI Global.
- Säljö, R. (2000). *Learning in practice. A socio-cultural perspective*. Bokförlaget Prisma.
- Shaw, D., M. (2011). Promoting Professional Student Learning Through Study Groups: A Case Study, *College Teaching*, 59(2), 85–92. <https://doi.org/10.1080/87567555.2010.550956>
- Shearer, R. L. (2009). Transactional distance and dialogue: An exploratory study to refine the theoretical construct of dialogue in online learning. Pennsylvania State University, University Park.
- Sheridan, K. M., & Wen, X. (2020). Evaluation of an Online Early Mathematics Professional Development Program for Early Childhood Teachers. *Early Education and Development*, 1–15. <https://doi.org/10.1080/10409289.2020.1721402>
- Sun, N., Rau, P. P.-L., & Ma, L. (2014). Understanding lurkers in online communities: A literature review. *Computers in Human Behavior*, 38, 110–117. <https://doi.org/10.1016/j.chb.2014.05.022>
- Tseng, F. C., Kuo, F., Y. (2014) A study of social participation and knowledge sharing in the teachers' online professional community of practice. *Computers & Education* 72 (2014) 37–47 <https://doi.org/10.1016/j.compedu.2013.10.005>
- Tømte, C., Fevolden, A. M. & Aanstad, S., 2017. “Massive, Open, Online and National? A Study of How National Governments and Institutions Shape the Development of MOOCs.” *The International Review for Research in Open and Distributed Learning (IRRODL)* 18 (5).
- Tømte, C., E., Sjaastad, J. & Aanstad, S. (2017) Evaluering av videreutdanningstilbudet MatematikkMOOC 2016–17. Et storskala videreutdanningstilbud for matematikklærere i barneskolen. [Evaluation of a large scale professional education programme for teachers in mathematics] NIFU: Rapport 54/2017.
- Ulriksen, Robin & Gjerustad, Cay (2017) Deltakerundersøkelsen 2017. Resultater av en spørreundersøkelse blant ansatte i skolen som har tatt videreutdanning i regi av strategien «Kompetanse for kvalitet. [Survey to participants in the Competence for Quality programme ]NIFU: Rapport 21/2017.
- Vangrieken, K., Dochy, F., Raes, E., & Kyndt, E. (2015). Teacher collaboration: A systematic review. *Educational Research Review*, 15, 17–40. <https://doi.org/10.1016/j.edurev.2015.04.002>

- Vivian, R., Falkner, K., & Falkner, N. (2014). Addressing the challenges of a new digital technologies curriculum: MOOCs as a scalable solution for teacher professional development. *Research in Learning Technology*, 22. <https://doi.org/10.3402/rlt.v22.24691>
- Vu, P., Cao, V., Vu, L. & Cepero, J. (2014) Factors driving learner success in online professional development. *The International Review of Research in Open and Distance Learning*, 15(3), 121–139. <https://doi.org/10.19173/irrodl.v15i3.1714>
- Vygotsky, L. (1978). Interaction between learning and development. In M. Cole (Ed.), *Mind in society*. Harvard University Press.
- Wenger, E. (1998). *Communities of practice: Learning, meaning, and identity*. Cambridge University Press.