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The impact of professional development training on faculty's integration of universal design for learning in daily teaching practices

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ABSTRACT

Even though Inclusive Education (IE) is required both legally and socially, it is often not implemented in the day-to-day teaching practice of faculty in higher education (HE) institutions. Professional development (PD) training is considered an important means to address this discrepancy, however, its impact on the long-term implementation of IE is unclear. This exploratory study is the first of its kind to systematically investigate the impact of three factors – PD training design, participant characteristics and organisational culture – on faculty's subjective learning gains and the sustained integration of universal design for learning (UDL). Utilising a quasi-experimental design, we administered a survey to faculty members who had engaged in various PD trainings related to UDL at a prominent Norwegian university. Our findings indicate that HE institutions should establish two conditions to support faculty in the implementation of UDL in their teaching practice: extended training rather than brief sessions and creating platforms for ongoing discussions on UDL even beyond the training.

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Introduction

Although disparities in education have been reduced in recent years, marginalised and underrepresented groups still face unequal access to higher education, lower levels of social integration, a decreased sense of belonging and higher rates of attrition (Leake and Stodden 2014; Hoffman and Toutant 2018). Inclusive education (IE) is defined by Morgan and Houghton (2011, 5) as a 'design approach […] that takes into account students' educational, cultural and social background and experience as well as the presence of any physical or sensory impairment and their mental well-being'. The right to IE is not only laid down in international treaties and global agreements (United Nations 2006;

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United Nations 2015; European Commission 2017), but in many countries also in national legislation (e.g. in Norway: Equality and Anti-Discrimination Act 2018).

In the context of Norwegian higher education, Inclusive Education (IE) comprises two distinct areas: (a) Individual Accommodations (IA), which are provided through specialised services managed by IA offices to address specific accommodation needs on an individual basis, and (b) Universal Design for Learning (UDL) as a collective responsibility of all faculty and staff to create inclusive learning environments by proactively addressing the diverse needs and preferences of learners from the outset.

Training faculty in IE is considered an important means of making education more inclusive. This is reflected in both researchers (de Beco 2014; Hauerwas and Mahon 2018) and public organisations (United Nations 2006; Ministry of Education and Research 2021) calling for strategic plans for the competence development of 'those who develop, implement, and evaluate inclusive curricula' (Smucker 2022, 6). At the same time, many educators report lack of training, a feeling of unpreparedness and lack of support as the main barriers to implementing IE (Castellano, Pozo, and Ruiz 2022; Chow and Sharma 2022).

The Convention on the Rights of Persons with Disabilities (CRPD) specifies that educators 'on all levels of education' (United Nations 2006) should receive ongoing support and training on IE in order to build their knowledge, skills and values. Faculty in higher education typically rely on professional development (PD) training offered by their institutions as the primary means to enhance their knowledge and skills in teaching, learning and assessment, including aspects related to inclusive education. In line with Darling-Hammond et al. (2017, 2), we understand PD as 'structured professional learning that results in changes to teacher knowledge and practices, and improvements in student learning outcomes'. Several studies over the past decades have shown that participation in PD training does not necessarily imply a successful application in the day-to-day teaching practice (de Beco 2014; Hauerwas and Mahon 2018). However, systematic research on factors which might help to increase the long-term effect of PD offers in higher education is scarce so far (for exceptions, see Steinert et al. 2016; Vreekamp et al. 2023). Moreover, Guskey and Sparks (1991) criticise that many studies neglect differences between different training formats.

Our exploratory study contributes to closing these research gaps. To the best of our knowledge, this is the first study systematically exploring the extent to which three factors impact faculty's subjective learning gains from PD training and the long-term use of UDL: the design of the PD training, participant characteristics and the organisational culture in which UDL is implemented. In our study, we emphasise UDL over IE, as our target group consisted of faculty members teaching in Norwegian higher education. Our respondents had participated in four different types of PD training on UDL at a prominent Norwegian university. Our quasi-experimental design allows us to make a unique contribution to the field by revealing systematic differences in the impact of various PD training types on subjective learning gains and the long-term use of UDL. With this, we contribute to enhancing the design of future PD training, enabling HE institutions to better support their faculty in creating inclusive learning environments for all students.

Literature review

According to Baldwin and Ford (1988), three factors can influence the effect of PD training: (1) the design of the training, (2) participant characteristics and (3) the participants'

organisational culture (academic environment). In the literature review below, we will look at current research on how these factors affect the participants' subjective learning gains and the long-term use of UDL in their daily teaching practice.

Design of the training

Regarding the design of PD training, the literature points to three key aspects: its format, content and activities. Workshops are a commonly utilised format in faculty training (Lycke 1999) and strongly discussed in the research literature. Some researchers have a more limited understanding of workshops as a merely 'traditional lecture based and stand-alone' training (Misquitta and Joshi 2022, 2) or as 'traditional, one-day "drive-by" models' (Darling-Hammond, Hyler, and Gardner 2017, 15) that are 'episodic and fragmented' (15). They argue that changes in practice cannot be achieved through such brief trainings, as these lack multiple opportunities for practice and cannot be tailored to each participant's individual context (Lycke 1999; Darling-Hammond, Hyler, and Gardner 2017; Laksov et al. 2022). Other researchers contend that workshops specifically concentrate on the individual participant, thereby increasing their motivation and awareness. Consequently, they can contribute to teaching effectiveness if found useful, relevant and informative (Weimer and Lenze 1991). Even brief workshops can positively impact the quality of teaching by building the teacher's self-confidence (Benor and Mahler 1989).

One criticism of PD training on IE is that they often focus on generic didactic models, rather than empowering faculty to address their students' diversity in various situations through inclusive strategies and methodologies (Pedaste et al. 2021; Castellano, Pozo, and Ruiz 2022). Hauerwas and Mahon (2018) suggest that IE training should strive to shift teachers away from a medical understanding of student needs, where they see themselves as caring and empathetic, to a social understanding where teaching strategies are designed to facilitate equal and equitable participation for all students. Their study targeted special education teachers in secondary education, but the findings are applicable to higher education.

Finally, researchers also link the success of PD training to the participants' sense of autonomy and their choice of hands-on activities (Breda, Clement, and Waeytens 2003; Craig, Smith, and Frey 2022; Laksov et al. 2022). All of the PD training in our study included video and reading resources on the topics, collaborative tasks such as peer-teaching, group discussions, or coaching by one of the authors, and simulations that enabled participants to experience a non-inclusive scenario. Simulations might ask participants to wear special glasses or noise-cancelling headphones (visual/hearing impairments), completing additional tasks while simultaneously participating in group activities (concentration difficulties) or to use the 'wrong' hand or gloves while typing on keyboards (motoric challenges). According to Laksov et al. (2022), these active learning strategies support the effect of PD training by increasing the participants' motivation, engagement and feeling of competence. Darling-Hammond, Hyler, and Gardner (2017, 7) define active learning as

> an 'umbrella' element that often incorporates the elements of collaboration, coaching, feedback, and reflection and the use of models and modelling. Opportunities for 'sense-making'

activities are important. Such activities often involve modelling the sought-after practices and constructing opportunities for teachers to analyse, try out, and reflect on the new strategies. Active learning opportunities allow teachers to transform their teaching and not simply layer new strategies on top of the old.

Participant characteristics

Two closely connected concepts crucially influence the impact of PD training: participants' previous experiences with and knowledge of IE, and their motivation for participation.

Concerning previous experiences and knowledge, Boyle et al. (2022) state that PD training should consider how the participants' experiences, culture and disability awareness can influence their instructional beliefs, consequently affecting the implementation of IE. If PD training can create opportunities for participants to recognise their beliefs based on previous experiences with students with diverse needs, and subsequently generate positive experiences through a subjective gain in knowledge and competence, this might also have a more long-lasting impact on their implementation of UDL. Several studies have shown that experiences where faculty felt unprepared, untrained and unsupported in a given situation, had a negative impact on the implementation of IE (Hauerwas and Mahon 2018; Boyle et al. 2022; Chow and Sharma 2022). Educators who have requested or received PD training, on the other hand, typically exhibit more positive attitudes towards IE (Castellano, Pozo, and Ruiz 2022; Chow and Sharma 2022). This is reinforced even further if they perceive they have resources and support readily available, along with the time to implement changes in their teaching practice (Chow and Sharma 2022). Breda, Clement, and Waeytens (2003), however, state that further research should examine the educators' changes in practice after an extended period, as the training might have had an immediate but only temporary effect on the educators' conceptions of inclusive teaching, without resulting in a coherent new belief system.

Regarding the faculty's motivation for participating in PD training, researchers have used various models to explain the relationship between what Gegenfurtner et al. (2009, 406) term 'pre-training motivation to learn' and 'post-training motivation to transfer'. In their study, Daumiller et al. (2021) examined how faculty members' achievement goals before PD training and their engagement influenced the learning outcome. They discovered that faculty who did not voluntarily participate in PD training often exhibited work-avoidance goals, with the objective to '"get by" with minimal effort' (2021, 18-19). This, in turn, led to lower engagement and diminished learning outcomes. The researchers recommend that developers of PD training should prioritise strengthening the participants' achievement goals rather than concentrating solely on learning outcomes to enhance implementation. Jaramillo-Baquerizo et al. (2021) applied the Self-Determination Theory by Ryan and Deci (2017) in their analysis of design approaches to PD training in Ecuadorian higher education. They discovered that the faculty members' need for autonomy in deciding whether and how to participate in PD training greatly influences the internalisation and subsequent application of their new knowledge in their teaching practices.

Several studies note that compulsory participation in PD training can result in lower motivation, reluctance and even defiance from the participants (Jaramillo-Baquerizo

et al. 2021; Vansteenkiste, Ryan, and Soenens 2020). Other studies, however, argue that there is no direct relationship between mandatory participation and the participants' commitment. Both Lycke (1999) and Ferman (2002) found that even when faculty perceive their participating in training as merely fulfilling institutional requirements, they still consider it a necessity in their professional development that must be addressed. However, making participation voluntary does not in itself guarantee higher subjective learning gains (Timperley 2008). Participants might expect to learn about new tricks and tools (Wilson and Berne 1999) and not to have to 'engage in in-depth learning or make substantial changes to their practice' (Timperley 2008, 16). Indeed, there are still gaps in the research literature on the nature of participation. For example, Jaramillo-Baquerizo et al. (2021) advocate for further research on how PD training should be organised to optimise the participants' motivation.

Organisational culture

The organisational culture in which the participant applies the knowledge and skills gained from the PD training is the third factor influencing the effectiveness of the training (Guskey and Sparks 1991; Darling-Hammond, Hyler, and Gardner 2017; Pedaste et al. 2021). Several researchers criticise that research on the effects of PD training relies on the self-reported satisfaction of the participants (Lycke 1999; Wilson and Berne 1999), the 'weakest type of evidence' (Lycke 1999, 130), and that the educators' support needs outside of the formal training are not taken into account (Breda, Clement, and Waeytens 2003; Chow and Sharma 2022). They advocate for further research on the participants' teaching practices before, shortly after and an extended period after the training, examining how their teaching context has influenced these practices (Wilson and Berne 1999; Stes, Clement, and Van Petegem 2007).

A supportive organisational culture and leadership are key to what Laksov et al. (2022, 271) call 'the challenge of obtaining legitimacy from practice'. They state that 'any change that people strive to implement is impacted by the social setting, its history, its ways of doing things, and impacts the opportunities for change agency for individuals' (270–271). This necessitates faculty making a conscious choice to uphold their new practices after the PD training and having the ability to implement them within their academic system, under manageable conditions and with confidence (Breda, Clement, and Waeytens 2003; Ho 2000). Faculty need to know that their efforts in implementing changes in their teaching practices are valued by their environment. According to Stes, Clement, and Van Petegem (2007), the most significant constraint on the effectiveness of PD training can be the absence of consensus with colleagues. For instance, colleagues might reject attempts to change teaching practices because they anticipate a heavier workload in making their teaching more inclusive (de Beco 2014), or because they struggle to perceive disabilities not as a medical defect, but as a barrier created by society (Hauerwas and Mahon 2018; Smucker 2022).

Collaboration with colleagues is considered to be another key factor for a long-lasting effect of PD training (Lycke 1999; Darling-Hammond, Hyler, and Gardner 2017). Moreover, collaboration with experts who can model good practice and share their expertise and experience can be stimulating and motivating (Darling-Hammond, Hyler, and Gardner 2017; Misquitta and Joshi 2022).

Relationship between learning gains and long-term use of UDL

Another interesting question is whether a reciprocal relationship exists between the impact of PD training on the subjective learning gains and the long-term use of UDL in the faculty's teaching practice. For example, it is plausible that heightened subjective learning gains may enhance teachers' confidence in implementing UDL in their teaching and thereby potentially increasing its long-term use. According to Ajzen's (2005) theory of planned behaviour, the long-term use of a behaviour (in this case, implementing UDL) is influenced by intentions which are, in turn, influenced by perceived behavioural control (potentially heightened with increased subjective learning gains), attitudes and subjective norms. However, given the limited research on this topic, we pose an open-ended research question.

Research questions

Starting from the literature review presented above, we derive five research questions. Concerning the impact of the design of the PD training, we ask:

> RQ1. How does the design of the PD training influence the participants' subjective learning gains (RQ1a) and the long-term application of UDL in their daily teaching (RQ1b)?

Regarding participant characteristics, we explore the impact of two factors – prior experiences with UDL and voluntary vs. compulsory participation in PD training – on subjective learning gains and the long-term use of UDL, and ask:

> RQ2. How do prior experiences with UDL impact the participants' subjective learning gains of PD training (RQ2a) and the long-term use of UDL in their daily teaching (RQ2b)?

> RQ3. How does the voluntary vs. compulsory nature of participation affect the participants' subjective learning gains of PD training (RQ3a) and the long-term implementation of UDL in their daily teaching (RQ3b)?

Regarding the participants' organisational culture (academic environment), we ask:

> RQ4. What impact does the organisational culture have on the participants' subjective learning gains of PD training (RQ4a) and the long-term integration of UDL in their daily teaching (RQ4b)?

Finally, given the limited research on the relationship between learning gains and the long-term use of UDL, our last research question is:

> RQ5. Does a correlation exist between the subjective learning gains of PD training and the long-term integration of UDL?

PD training on UDL in Norwegian higher education

While most teachers in primary and secondary education in Norway typically receive formal education through mandatory teacher training programmes, formal teaching competencies were not legally required in higher education until 2017 (Ministry of Education and Research 2017). Before 2017, many institutions had institutional requirements, but these were often loosely enforced due to a limited number of available

spots in PD programmes. Even after 2017, only newly hired faculty or those aspiring to apply for promotion to associate or full professorship are required to complete a 200-hour basic pedagogical training.

According to the University and University Colleges Act (2005, §4–3), all HE institutions are mandated to guarantee the universal design of their 'general functions', encompassing both the physical and digital learning environment of the institution. However, UDL is typically excluded from the content addressed in PD training, whether they are basic pedagogical training or other types of training. This omission may stem from institutions perceiving inclusion primarily as individual accommodations for individual students, leading them to allocate resources primarily to dedicated services. Moreover, given the substantial workload that most faculty members bear with both teaching and research obligations, incorporating UDL as an additional requirement may appear unrealistic.

When UDL is incorporated into training or implementation measures, the focus typically revolves around students with diverse disabilities or mental health conditions. This is mainly because other background aspects play a less dominant role in Norway where the well-established social welfare system enables students from all socio-economic backgrounds to pursue higher education. Additionally, Norway's characteristics as an egalitarian country – boasting a relatively small population of just 5.4 million, a unitary state system and a highly participatory democratic society – further contribute to this approach.

Most existing research stems from studies within the US-American and Canadian context, with different didactic and political approaches to IE. Our study provides a European perspective. Second, even within Europe, many countries exhibit significant heterogeneity in their student populations rendering findings potentially non-generalisable across institutions. In Norway, a smaller population and fewer institutions make our study more representative of our country. And third, unlike many other countries, Norway has mandated initial PD training for faculty across diverse backgrounds and contexts, resulting in a more diverse sample of participants.

Methods

Sample and data collection

To answer our RQs, we conducted a survey with faculty who had participated in one of four different PD training types on UDL between 2018 and 2020 at a prominent university in Norway. All participants took part in only one training. All training types had a workshop format and targeted the same content and intended learning outcomes: They included an introduction into UDL and the faculty role, guidance on universally designing digital learning resources and teaching, learning and assessment activities. By shifting the focus away from laws and regulations and highlighting the role that faculty play in cultivating students as expert learners (Rose, Meyer, and Gordon 2023), all training targeted learning outcomes geared towards enhancing faculty's social understanding of equity. This in turn, was intended to facilitate the subsequent integration of UDL into their teaching practices. Consistent with Darling-Hammond, Hyler, and Gardner (2017), two key principles guided the PD training. Firstly, all PD sessions

demonstrated the principles of UDL. Secondly, participants could choose various elements within their own courses – such as learning material, activities or student assessment tasks – and apply these principles. Aiming to make it easier for participants to continue their new practices after the training, participants were encouraged to initiate the redesign of their teaching practices with guidance during the training. All training types were led by the first author.

Along with these similarities, however, there were several differences between the training types, mostly related to the fact that they varied in duration: (1) a half day (3 h) workshop as part of the compulsory basic educational competence programme for all faculty teaching in Norwegian higher education, (2) a full day (six hour) workshop targeted at whole departments, (3) a full day (six hour) workshop targeted at specific groups (e.g. international faculty, supervisors) with voluntary registration and (4) a semester-long training (20 h) open to all faculty at the university. Training 3 and 4 were presented in an identical manner twice each (for an overview of the sample, see Table A1 in the Appendix). Thus, while the activities were the same, the time and depth that participants could spend on each activity varied with the duration of the training. Despite not being part of the original plan, these variations provided a unique setting for a quasi-experimental design (similar to planned variation as described by Guskey and Sparks (1991)).

After obtaining ethical approval by the Norwegian Centre for Research Data, 199 participants were contacted through the university's learning management system and asked to fill in a questionnaire on their subjective learning gains and long-term effect of the PD training. Data was collected from November 5 to December 14, 2020. Depending on the specific training completed, the time between the completion of the training and data collection ranged from 6 to 24 months. Overall, 54 participants filled in the questionnaire (overall response rate: 27%).

Measurement

All participants received the same questionnaire at the same point in time, independent of which training they had completed. They could choose between a Norwegian and an English version of the questionnaire both of which were identical content-wise. The questionnaire contained a total of around 30 questions, including several filter questions and open questions on definitions, elaborations, or additional comments. The questions used in the following analyses can be found in Table A2 in the Appendix.

Design of the training. This was operationalised by the *length of the PD training* as measured by hours: 3 (group 3), 6 (groups 1 and 2), or 20 h (group 4).[1]

Participant characteristics. These were measured by means of multiple (sets of) variables: For measuring the participants' prior *experience with UDL*, we asked them to indicate on a four-point scale (0 = do not remember (recoded into missing value); 1 = not at all; 2 = to a small extent; 3 = to some extent, 4 = to a large extent) if they had already had experience with (a) students with different needs and backgrounds and (b) students who received individual accommodations, before they participated in the PD training. Both items were highly correlated (Spearman's rho = .865; $p < .001$) and were therefore combined into an average index. For measuring the *mandatory participation in the training*, we used a question on the reasons why faculty participated in the PD training. The four answer options were: because (1) the training was mandatory, (2) their department or

colleagues were also participating, (3) they were interested in learning about the topic, (4) they already had some experience with UDL and wanted to learn more. Multiple answers were possible. In our analyses, we differentiated between participants who indicated with option a that the participation was mandatory (= 0) and those who did not (= 1), which we interpreted as voluntary participation.

Organisational culture. The context in which the participants applied UDL at the time of the survey was operationalised by means of two questions: They were asked if they, after their participation, had (a) *conversations with others in their academic environment/department* about UDL, and (b) *colleagues in their academic environment/department who apply UDL in their teaching practice*. Both questions were originally open qualitative questions in the questionnaire which were recoded by one of the authors into two binary variables (0 = no, 1 = yes).

Subjective learning gains. The subjective learning gains were operationalised by means of seven variables. Four variables addressed *theoretical learning gains*: The participants were asked to remember back to right after the PD training and to indicate whether they felt they had gained new theoretical knowledge about (a) UDL vs IA, (b) UD of learning resources, (c) UD of teaching and learning activities and (d) UD of assessment. Three variables addressed *practical learning gains*: whether the participants felt they had gained new or increased practical knowledge about (a) UD of learning resources, (b) UD of teaching and learning activities and (c) UD of assessment. All seven questions were measured on the same four-point scale (0 = do not remember (recoded into missing value); 1 = not at all; 2 = to a small extent; 3 = to some extent; 4 = to a large extent). We calculated two additive sub-indices, one for theoretical and one for practical learning gains both of which exhibited sufficient internal consistency (Cronbach's alpha = .82 and .86; for the joint scale of all 7 items: Cronbach's alpha = .90). Since both sub-indices were highly correlated ($R = .742$; $t(52) = 7.988$; $p < .001$), we combined them into an average index for subjective learning gains.

Long-term use of UDL. For measuring the long-term use of UDL in their own teaching, the participants were asked to indicate on a four-point scale if they still used UDL in their teaching practice at the time of the survey (0 = do not teach currently (recoded into 1), 1 = not at all, 2 = to a small extent, 3 = to some extent, 4 = to a large extent).

Controls. Since the time passed since the training offer might affect how strongly the participants have implemented UDL in their training, we included the *months since the completion of the training* (see Table A3, A4 in the Appendix) as controls in our models.

Analyses

To answer our research questions, we defined a structural equation model that seeks to explain (a) the subjective learning gains and (b) the long-term use of UDL in teaching (endogenous variables). As predictors (exogenous variables), we considered the design of the training, the participant characteristics and the organisational culture as described above. We defined subjective learning gains as a continuous/metric variable while defining the use of UDL in one's teaching as an ordered variable. The model was calculated using the lavaan package for R (Rosseel 2012), that employs diagonally weighted least squares (DWLS) to estimate model parameters if ordered endogenous variables are present.

Results

When interpreting the findings, we need to keep in mind that some of the data are self-reported and collected two years after the experience of the participants, which might bring along some measurement errors. Descriptive statistics can be found in the Appendix. First, we tested whether the subjective learning gains through the training mediated the relationships between the independent variables and the long-term use of UDL (RQ5). However, the model fit of the path model was insufficient (indirect model: $\chi^2(df = 6) = 7.428$; $p = .283$; CFI = .357; TLI = .893; RMSEA = .068; SRMR = .018) (Appendix, Figure A1).

Therefore, we tested an alternative path model with both subjective learning gains and long-term use of UDL as dependent variables. The revised model included direct effects of the independent variables on both learning gains and long-term use of UDL and excluded the mediation process. The revised model proved tenable (direct model: $\chi^2(df = 0) = .000$; $p < .001$; CFI = 1.000; TLI = 1.000; RMSEA = .000; SRMR = .000; Figure 1). Since this was a fully saturated model, we tested the fit of an alternative model formulation from which we excluded all coefficients with a p-value of .5 or greater (ex post) to increase model parsimony. The results (combined model: $\chi^2(df = 0) = .000$; $p < .001$; CFI = 1.000; TLI = 1.000; RMSEA = .000; SRMR = .000) confirmed that the model formulation without the mediation described the data better.

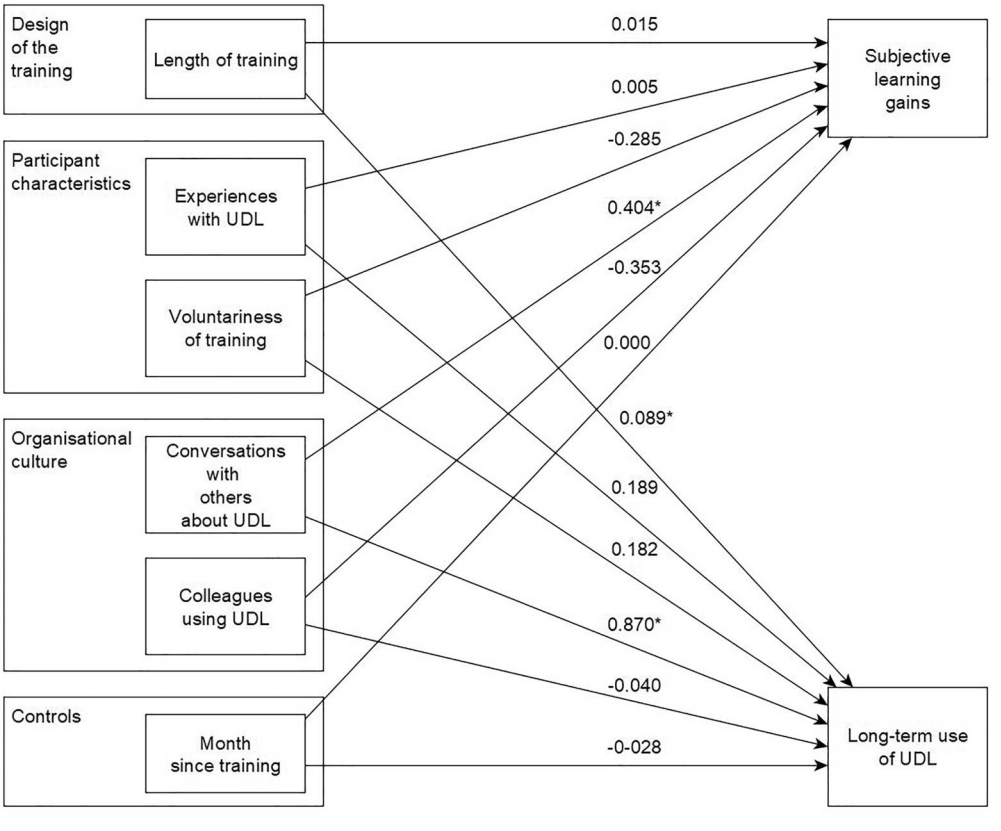

Figure 1. Influencing factors on subjective learning gains and long-term use of UDL. $n = 53$. Maximum likelihood estimation.

Subjective learning gains

First, we tested which factors affected the subjective learning gains (Figure 1). There was no statistical evidence that the hours of training (RQ1a) or the participant characteristics we considered – prior experience with UDL (RQ2a) and a compulsory vs. voluntary participation in the training (RQ3a) – affected the subjective learning gains. Regarding the organisational culture (RQ4a), we found that conversations with others about UDL increased the subjective learning gains significantly ($p = .025$) while we found no significant effect of colleagues using UDL on the subjective learning gains.

Long-term use of UDL

Next, we tested factors affecting the long-term use of UDL in the participants' daily teaching (Figure 1). For the design of the training as measured by the number of hours, we found a significant positive effect ($p = .024$) (RQ1b), meaning that the longer the training, the higher the probability that the participants continue to use UDL. For the participant characteristics, we found that neither prior experiences with UDL (RQ2b) nor compulsory vs voluntary participation made a difference for using UDL (RQ3b). Regarding the organisational culture, we found that conversations with others about UDL increased the use of it significantly ($p = .010$) while it did not matter whether others at the own department also use UDL (RQ4b).

Discussion

While inclusive education is required both legally and socially, it is often not implemented in the day-to-day teaching practice of faculty in HE institutions. PD training is considered an important means to address this discrepancy, however, its impact on the long-term implementation of IE is unclear. To address this research gap, we examined the impact of the design of PD training on UDL, participant characteristics and the organisational culture on the faculty's subjective learning gains of the PD training and their use of UDL in their daily teaching practice at a larger university in Norway.

Regarding the design of the training (RQ1), the duration of the PD training did not make a difference for how much the participants felt they had learned about UDL. This might be explained by the fact that all training had the same content and activities, and one could argue that a shorter training would be sufficient to obtain the same learning gains. However, our findings also show that spending more time on the training had a significant effect on the participants' long-term use of UDL. This indicates that even though longer training does not lead to a feeling of having learnt more, spending more time on the training and applying the new knowledge under professional guidance for an extended period makes it easier for faculty to integrate their new knowledge into their daily teaching practices.

Contrary to existing research (Chow and Sharma 2022; Hauerwas and Mahon 2018; Boyle et al. 2022), we found that prior experience with students with support needs (RQ2) did not have any impact, either on subjective learning gains or on the long-term utilisation of UDL. However, the activities in the training were designed to

enhance the participants' understanding of students with support needs by creating *new* experiences through simulations and demonstration of the UDL-principles. These activities could have either counteracted or complemented prior experiences.

In terms of compulsory vs. voluntary participation (RQ3), we did not find any significant effects, neither on subjective learning gains nor on the long-term use of UDL. This finding aligns with Lycke (1999) and Ferman (2002) suggesting that faculty perceive PD training as tasks to complete rather than ongoing commitments.

Concerning the participants' organisational culture (RQ4), we found that conversations with others about UDL had a significant impact, leading to higher subjective learning gains and a stronger long-term use of UDL. Conversations with colleagues might help lower reluctance and the feeling of being alone, in line with Jaramillo-Baquerizo et al. (2021) who recommend that PD training should include elements to reduce feelings of isolation after the training. In contrast, colleagues who also use UDL in the participants' academic environment did not affect either the subjective learning gains or the long-term use of UDL which contradicts current research (Darling-Hammond, Hyler, and Gardner 2017; Misquitta and Joshi 2022).

Finally, we did not find any relationship between subjective learning gains and the long-term use of UDL (RQ5). Thus, the sense of having learned something about UDL does not necessarily imply its incorporation into one's own teaching.

Naturally, our study has some limitations. Even though our data came from four different PD training types over an extended period, our limited sample size, with a low number of participants in some instances and a low response rate, hinders the generalisation of our findings to other contexts. Due to the small sample size, the statistical power is low. As a result, our findings likely reflect relatively robust and strong effects while null findings hold little value. Our data are inadequate for ruling out any mechanisms, and we can only find very strong data signals. What we did not find may still be there and relevant, though likely moderately strong or weak. Furthermore, some of our data are self-reported and were collected up to 24 months after the participants' experiences, which may introduce measurement errors, among others due to social desirability (Krumpal 2013) and memory issues. However, the questionnaire proved suitable as a measuring instrument that can be used for future panel studies, with a pre-training survey, a post-training survey immediately after the training and a post-training survey a longer time after.

To triangulate our research, conducting interviews with participants could enhance our understanding of the findings. In addition, we suggest more research on aspects such as attitudes towards UDL or subjective norms, which we did not include in our survey, but which might be relevant in line with the theory of planned behaviour (Ajzen 2005). Even though there is a lot of research on the impact of attitudes on the implementation of inclusive education, research on how PD training might influence these attitudes is scarce. Finally, we recommend variations of our quasi-experimental design which do not keep the content constant and vary other factors but rather keep the length and target group constant while varying the content and activities. In this manner, one could ascertain whether an approach like ours, with an emphasis on fostering personal participant experiences, is the most effective way to ensure an inclusive learning environment for all students.

Conclusion

For a more effective long-term integration of UDL into the daily teaching practices of higher education faculty, we suggest that PD training should 1) have a longer duration to enable a gradual and step-by-step implementation of new knowledge, and b) establish platforms for faculty to continue conversations about UDL beyond the PD sessions.

Institutions must recognise UDL implementation as a continued PD training, which can be motivating for faculty, as it legitimises their efforts in integrating UDL into their daily practice. This approach can also help raise awareness about the importance of UDL among faculty who have not participated in any PD training. This underscores the crucial role of institutions in taking responsibility for a comprehensive UDL implementation, rather than treating it as an individual task for faculty.

Note

1. In an earlier version of the model, we tested whether having undergone the training in (group 1) vs outside the departmental context (groups 2, 3a/b, 4a/b) made a difference for subjective learning gains and subsequent use of universal design. However, group membership did not have an influence beyond the length of the training. Therefore, in our analyses, we combine groups 1 and 2, both of which received 6 h of training.

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