



Co-Constructing Multidisciplinary Coherence in Subject Teacher Education: Students' Reflections in Group Discussions

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Abstract

This article examines how disciplinary coherence is (co)constructed at the student-oriented level in pedagogical studies at the University of Turku. Based on group discussion data, we analyze how coherence is (co)constructed in planning a mutual multidisciplinary learning module on the topic of sustainable development. The focus is on how students talk about their own discipline and its specific nature in relation to other disciplines and the multidisciplinary modules. From the perspective of (co)constructing coherence in relation to multidisciplinary modules, three different types of coherence building discourses were identified from the data. It was interesting how, on the one hand, one's own discipline and subject boundaries seem to be valued, and on the other, how this subject-orientation is questioned and seen as problematic. Based on our findings, we discuss how the participants' discourses of multidisciplinary relate to the conceptualization of different dimensions of disciplinary coherence (i.e., inter-, multi- and transdisciplinary) and what this means for the development of teacher education.

Keywords

Coherence • Multidisciplinary • Interdisciplinarity • Transdisciplinarity • Pre-service subject teachers

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7.1 Introduction

Coherence has already been on the agenda for teacher education for some time (e.g., Canrinus et al. 2019; Darling-Hammond et al., 2017; Hammerness, 2006) and it can be approached from different perspectives. Coherence can be divided into conceptual and structural coherence, although they often partly intersect (Hammerness, 2006). Conceptual coherence refers to, for example, an appropriate combination of theory and practice or a shared understanding of the teaching that underpins the whole program. Structural coherence may manifest in alignment of courses around a particular educational concept or organizing the courses in a way in which they build on and reinforce one another. Coherence can also be approached through the dimensions of horizontal and vertical coherence (Broad et al., 2013). The former refers to coherence during the studies whereas the latter refers to coherence across the entire teacher education program. According to Boning (2007), a coherent education program is one in which students can make connections and integrate knowledge, as opposed to a set of disconnected individual courses which provide individual and isolated chunks of information. Coherence can refer to connections within several dimensions, for instance, within disciplines (Faulconer et al., 2020) or between theory and practice (Grossman et al., 2008). In this study, however, our focus is primarily on coherence across disciplines (e.g., Gentzler, 2003) and how it is co-constructed by the participants in group discussions where they talk about multidisciplinary learning.

Although coherence is often presented in an overly positive sense, Richmond et al. (2019) aptly highlight that coherence is not an entirely unproblematic concept. They argue for a certain built-in flexibility in order to challenge future teachers to explore alternative ideas and realities. Instead of having an achievable endpoint, coherence should be viewed as an ongoing process that involves all relevant parties collaboratively negotiating coherence. However, Tatto (1996) suggests that coherence does not necessarily mean complete harmonization of the program since diverse thinking adds richness to the learning experience. Instead, she advocates that the learning is organized in a coherent manner.

In this article, we focus on the coherence of teachers' pedagogical studies at the University of Turku, Finland and, more specifically, in one course of subject didactics, where multidisciplinary is one of its key elements. Subject-specific didactics has a strong tradition in Finnish education (Kallioniemi & Virta, 2012). Harju-Autti et al. (2021) aptly point out that the term subject-specific didactics can itself be interpreted as a term associated with a single subject. Lehtonen et al. (2018) criticize teacher education for maintaining unnecessary

dichotomies, whereby information from opposing perspectives does not meet. Such dichotomies include natural versus human sciences, fact-based knowledge versus experiential knowledge, as well as the knowledge produced by the individual compared to the knowledge produced by the community. In this study, we are interested in the relationship between two perspectives, that is, subject-specificity and multidisciplinary.

We approach coherence across disciplines through the related concepts of *multidisciplinarity*, *interdisciplinarity* and *transdisciplinarity*. These concepts are often used interchangeably although they can be taken to mean slightly different things (e.g., Alvargonzález, 2011; Choi & Pak, 2006). Multidisciplinarity refers to the exploration of a unifying theme from the perspective of different subjects while maintaining clear boundaries between them (Choi & Pak, 2006; Drake & Burns, 2004; Klein, 2010). Conversely, transdisciplinarity means integrating sciences and perspectives in a way that transcends their boundaries. Connections are thus being built between disciplines or entirely new areas of knowledge are being created (Choi & Pak, 2006; Drake & Burns, 2004; Klein, 2010). According to Aarnio-Linnavuori (2018), transdisciplinary learning takes time and is challenging to implement as a one-off lesson or short module. Cantell (2017) suggests that transdisciplinary learning resembles transformative learning (e.g., Mezirow, 2006), since it questions current paradigms and critically reflects on the so-called truths in the existing world. Interdisciplinarity can be seen to fall somewhere between the two approaches above. In interdisciplinary learning, the integration of disciplines is more profound than in multidisciplinary learning but less strong than in transdisciplinary learning. The different disciplines are still kept independent but links and relationships are created between them (Choi & Pak, 2006; Drake & Burns, 2004; Klein, 2010). According to Choi and Pak (2006), multidisciplinary, interdisciplinarity and transdisciplinarity can also be described by the words *additive*, *interactive* and *holistic*, respectively. It is important to note that, to some extent, these concepts are overlapping and the same terms can refer to slightly different issues in different contexts. It is therefore interesting to examine how student teachers themselves understand and conceptualize multidisciplinary in our data in relation to their own subject and discipline.

In this article, we examine how the participants' understanding of disciplinary coherence in teaching and learning unfolds in group discussions organized in a course focusing on multidisciplinary. First, we will provide a brief overview of the course in question and its structure. Our focus, however, is on the students' perceptions of multidisciplinary and how it is implemented and how different subjects are linked together in a multidisciplinary learning module. In this article, we address the following research questions:

RQ1: How do the participants co-construct the understanding of multidisciplinary learning in the group discussions and what discourses for building disciplinary coherence can be identified in the group discussions?

RQ2: What is the participants' relationship with their own subject in relation to multidisciplinary, interdisciplinarity and transdisciplinarity?

7.2 Context of the Study

The context of this study is the University of Turku, Finland, where students complete their teacher's pedagogical studies during one academic year. Altogether, the studies are worth 60 ECTS credits, which consist of 20 ECTS of educational sciences, 20 ECTS of subject-specific didactics and 20 ECTS of teaching practicum. The subject didactics and teaching practice components of the studies are mainly carried out in their own subjects. Conversely, all students, regardless of their subject, attend the education lectures. However, the lectures are relatively lecturer-centered and there is not a strong emphasis on cross-disciplinary collaborative work.

In this article, the context of our data is the course: subject-specific didactics III. As part of this course, there is a series of lectures common to all students on educational topics that permeate all teaching. The lectures are offered on a variety of topics, such as multiliteracy, differentiation and sustainable development. Students can choose the lectures they attend and must attend a total of 16 h of lectures. An additional part of the subject-specific didactics III course is a multidisciplinary module that students plan. This is to prepare them for their future work as teachers, as the Finnish national core curriculum for basic education requires at least one multidisciplinary learning unit to be implemented each year. The lectures described above are meant to underpin and inform the planning of the multidisciplinary modules, which we describe in more detail in the following section.

7.3 Multidisciplinary in the National Core Curricula

The Finnish national core curricula provide a solid basis for disciplinary coherence. The curricula use the term *transversal competence* to refer to *an entity consisting of knowledge, skills, values, attitudes and will* (the Finnish National Agency for Education = FNAE, 2014, Sect. 3.3). The National Core Curriculum for Basic Education outlines seven transversal competencies, such as *cultural*

competence, multiliteracy and ICT competence, the aim of which is to *support growth as a human being and to impart competences required for membership in a democratic society and a sustainable way of living* (FNAE, 2014, Sect. 3.3). The six corresponding competences in the National Core Curriculum for General Upper Secondary Education include *multidisciplinary and creative skills, ethics and environmental competences* and *global and cultural competences* (FNAE, 2019, Sect. 6.2). In addition to these transversal competences that should transcend all learning, the curriculum for basic education stipulates that the education provider ensures that pupils' studies include at least one multidisciplinary learning module per academic year. The multidisciplinary modules contribute to the development of the transversal competences introduced above.

However, despite the disciplinary coherence promoted by the curricula, they are nevertheless very much fragmented into specific subjects and outline subject-specific objectives and content in each subject. Moreover, the approach to disciplinary coherence in the curricula is rather moderate. First, the curriculum for basic education uses the term *multidisciplinary learning* to refer to the modules in which phenomena are approached through different subjects. As discussed in the introduction, this term denotes a learning process in which subject boundaries are maintained (cf., interdisciplinary or transdisciplinary leaning). Secondly, the transversal competencies are also approached from a subject-specific perspective. The national core curriculum for basic education states that *each subject builds the pupil's competence through the contents and methods typical of its field of knowledge* (FNAE, 2014, Sect. 3.3). The curriculum for general upper secondary education talks about the transversal competencies in a similar vein.

7.4 Previous Studies on the Topic

Disciplinary coherence among pre-service teacher education has been the subject of some international research (e.g., Fitzgerald et al., 2021; Tanase & Lucey, 2017). The topic has been looked at from many perspectives, including team teaching (e.g., Coleman et al., 2023), online learning (e.g., Geiger et al., 2018) and curriculum implementation (e.g., Brand & Triplett, 2012). However, due to the scope of the present study, in this article we will concentrate only on studies carried out in the Finnish context, which provide background for our own research.

Disciplinary coherence in subject didactics is a rather unexplored terrain and there are only a limited number of studies that have examined Finnish pre-service teachers' views on multidisciplinary, interdisciplinary and transdisciplinarity.

Harju-Autti et al. (2021) explored 32 pre-service subject teachers' views on a multidisciplinary project carried out as part of their university studies. The authors were interested in how students saw the link between the experience of the joint project and their future working life. In the joint project, the students were tasked with designing a course for upper secondary school students that would combine the subjects of all the students in the group. The students came from two main disciplines, that is, foreign languages and social studies (i.e., history, philosophy, communication, psychology and political sciences). Overall, the students were very positive about the project and felt their perspectives were broadened and widened as a result of the multidisciplinary collaboration. The students described the project as having lowered the threshold for designing multidisciplinary courses in the future and as having generated insights into new cross-curricular projects.

Tarnanen et al. (2019) examined what pupils ($n = 250$), teachers ($n = 25$) and student teachers ($n = 23$) reported having learned in a multidisciplinary learning project with 5-8th graders. The students reported learning interaction skills to work with diverse groups of students and text production skills. The teachers reported learning more about co-operation with colleagues, the process of the interdisciplinary work and about their pupils. The student teachers highlighted learning about their own strengths and weaknesses, group dynamics, collaboration and the organization of the multidisciplinary unit. The authors conclude that their study showed that in a multidisciplinary learning approach, a teacher's role is very different from that of traditional teaching and learning. A teacher is more of a facilitator than a purveyor of knowledge and learning is very student-centered which can pose its challenges. The authors suggest that their experiment shows that the multidisciplinary skills and subject-specific skills can be studied in parallel, which is in line with the ethos of the Finnish national curricula.

Cantell (2017) explored pre-service subject ($n = 69$) and primary teachers' ($n = 35$) perceptions of the benefits and challenges of multidisciplinary learning. The results showed that, overall, the pre-service teachers' attitudes towards multidisciplinary were positive. The participants felt that a multidisciplinary approach can provide a better overall understanding of the content, compared to a subject-based approach. However, many also perceived combining multidisciplinary and different subjects as challenging. Lack of familiarity with multidisciplinary working and negative attitudes towards other subjects were mentioned as challenges.

Pre- and in-service teachers' attitudes towards disciplinary coherence can be assumed to have a direct impact on how it is implemented in schools. Venäläinen et al.'s (2020) study showed that there is room for improvement in how

the multidisciplinary modules in basic education are organized. They tend to be mainly projects or theme days and are thus characterized by their one-off nature. Pupils' involvement in the design of the multidisciplinary modules has also been limited and the design has not sufficiently taken into account the content objectives of the subjects. The assessment of learning during these modules has also proved problematic. On the other hand, the multidisciplinary modules have increased teachers' co-planning and collaboration. The authors conclude that a more in-depth focus on transversal competences as an objective of basic education would require more time for teachers to discuss and share good practices together. Teacher education should also prepare future teachers to take better account of multidisciplinary in their teaching.

7.5 Methods

Our research data consist of group discussions between teacher students of different subjects (e.g., foreign languages, Finnish language and literature, mathematics, history and social studies) recorded in autumn and spring 2021.¹ The data were collected as part of one of the general educational lectures on the topic of climate skepticism as a pedagogical challenge, which was an online lecture organized on Zoom. At the end of the lecture, the participants were asked to reflect in groups on how the topic of the lecture could be used in the design of a multidisciplinary learning module. In three separate group discussions, the students collaboratively tried to plan a multidisciplinary learning module around the lecture topic. Altogether, 12 students participated in the group discussions. The data comprises three audio- and video-recorded group discussions, totaling approximately 40 min, which have been transcribed verbatim.

The participants were asked for written consent before the lecture and they were informed about the study in advance with a detailed privacy notice. In the data extracts, the participants are anonymized and no information that could identify an individual participant has been included. The data has been stored securely on platforms provided by the university and is accessible only by the research team.

¹ The group discussions are part of the data for an ongoing research project in which researchers from different disciplines are working together to develop research-based teacher education for future subject teachers. In addition to the authors of the present study, the research group comprises the following researchers: Jan Löfström, Eija Yli-Panula, Anuleena Kimanen and Riia Kivimäki.

In this study, we focus on the ways in which pre-service subject teachers jointly construct multidisciplinary coherence and their perceptions of the planning and designing of multidisciplinary learning modules. We aim to link the exploration of disciplinary coherence emerging from the data to a conceptualization of multidisciplinary along the interdisciplinary-multidisciplinary-transdisciplinary axis.

For the data analysis, we apply discourse analytic and linguistic research methodology (e.g., Fairclough, 1992; He, 2017; Juez, 2009). The guiding thread of the analysis is the linguistic choices participants make in the discussions to build coherence between different disciplines and subjects as well as the thematic tendencies that can be identified in relation to multidisciplinary. We pay attention to the thematic and topical aspects of the discussion, the linguistic means and choices participants use to structure the relationship of their own subject and discipline to other subjects and disciplines, and the commonalities and interdisciplinary connections they build in the discussion.

7.6 Findings

From the group discussion data, we have identified three discourses through which disciplinary coherence in the design of a multidisciplinary learning unit was built: 1) the discipline/subject-oriented discourse of integration, 2) the broad unifying discourse and 3) the holistic discourse of change.

7.6.1 The Discourse of Discipline-Based Integration as a Coherence Builder

In the group discussions, a strong subject-oriented discourse was a very common way of building disciplinary coherence in the design of a multidisciplinary learning module. In this case, interdisciplinarity is seen above all as a somewhat mechanical integration of different disciplines:

1) If you want to make some banners for school, that could be one way of doing something like a full day, just to bring different subjects together. That hey let's write

multilingual posters about how you can make a difference or what decisions we can make. That could do some good. (GD2/21)^{2,3}

The subject-oriented discourse of integration reflects, on the one hand, the subject-oriented tendencies of the Finnish national curricula and, on the other, the strong subject-orientation in the participants' pedagogical studies. In this discourse, multidisciplinary teaching is constructed and understood primarily from the viewpoint of one's own subject, as illustrated by the following extracts:

2) My major is geography and minor biology. This climate change is according to the curriculum quite strongly present in our subject, of course it's in all subjects but substantively, it's particularly in our subject. (GD1/21)

3) I really started to think about this from a factual point of view, that in geography it's possible to look at the effects of climate change and perhaps also ways of preventing it. From both the natural and human point of view, to see what effects society has on this and how climate change affects society. (GD1/21)

In extract 2, the theme of a multidisciplinary learning module is linked to the content of the curriculum and the topic is considered a core theme from the point of view of the participant's own subject (*this climate change is according to the curriculum quite strongly present in our subject*). In extract 3, the interlocutor's subject-based orientation is reflected in the way they indicate the possibilities offered by their own subject to address the multidisciplinary theme (*in geography it is possible to look at the effects of climate change*). We interpret this as indicating not only a subject-based orientation, but also a strong subject-oriented identity among pre-service subject teachers, which is also reflected in extract 4, in which the participant emphasizes the specific possibilities of their subject in dealing with a multidisciplinary theme:

4) Especially when the teaching of religion and especially the teaching of ethics has its own special nature - exactly in general the classes of religious studies provide a very special opportunity to reflect on one's own living environment, worldview, personal opinions and ethics so that if it could be extended to other subjects, it would be a great thing. (GD3/21)

² The code refers to the number and recording year of the group discussion.

³ The quotes are direct translations from the group discussions held in Finnish. They have been slightly edited for the sake of clarity, for example by removing filler words and hesitation sounds.

As a coherence-building discourse, the discipline/subject-based integration discourse is rather mechanical and pragmatic. This is reflected in the linguistic formulations in the group discussion, for example in the way one's own subject is described as a subject that is easy to include in the multidisciplinary learning module, as illustrated by the following extract:

5) The first thing that came to mind was all the materials in language lessons that can be easily changed, or to use some texts on the subject or even encourage someone to search for information in the target language, or even organize a debate on the subject. Surely it would be easy to include English, in particular. (GD2/21)

The mechanistic and pragmatic nature of the discourse is also reflected in the orientation of the interlocutors in that multidisciplinary is conceived as a pedagogical activity in which all subjects are exhaustively included in one way or another, sometimes artificially as in extract 7 below:

6) You can really include all the subjects in it [=multidisciplinary learning module]. At least you can include some kind of links to all the subjects. (GD2/21)

7) Well, P.E. is perhaps a bit more difficult to include, perhaps there could be something like climate change tag or something. (GD2/21)

Particularly extract 7 highlights an orientation in which teaching and content are approached through different subjects rather than relevant phenomena and themes. Although the curriculum states that all subjects take turns in implementing the multidisciplinary learning modules, this should be done in a way that is appropriate to the module in question.

In this discourse, the construction of multidisciplinary coherence is reflected in the linguistic structures, for example in the verb choices reflecting orientation. Multidisciplinary coherence is verbalized by *including*⁴ (extract 8) or *embedding* (extract 9) content or themes that do not fundamentally belong to one's own subject, which at the same time underlines the subject-oriented and mechanical nature of the discourse in relation to the construction of coherence:

8) In maths you can include all sorts of bigger things that you might not think of at first. I did a lesson on taxation in maths recently where we went through the history of taxation. (GD2/21)

⁴ The original Finnish verb "ympätä" in these examples is semantically elevated and carries a metaphorical meaning of forced association. This contributes to underlining the subject-oriented nature of the discourse.

9) It's relatively easy to embed a climate perspective in social studies and history, but it was interesting how through foreign language teaching you can expand that perspective to a more global direction. (GD3/21)

Alongside the discourse of embedding things in one's own subject, extract 9 also illustrates the construction of another type of coherence in relation to multidisciplinary: expanding and broadening the scope of the topic from the viewpoint of one's own subject. This way one's own subject is seen as a platform against which to expand the construction of knowledge across disciplinary boundaries and through which to develop pupils' transversal competences, as extract 10 also shows:

10) It seems to me that dealing with these issues in a foreign language helps the students to understand and comprehend the issue because it's dealt with in a global way. It also involves the learners in the global discourse. And when they feel that they understand and have the vocabulary, it's perhaps easier to understand, then perhaps it would also broaden their views and their own opinions in some way. (GD3/21)

These last two data extracts (9 and 10) reflected a slightly deeper understanding of multidisciplinary compared to the other extracts with more mechanistic approach, also reflecting the ambiguity of the construction of multidisciplinary understanding. Therefore, they resemble the next level of discourse we have identified, that is, the broad unifying discourse, which we will discuss in more detail next.

7.6.2 A Broad Unifying Discourse in Building Coherence

Another coherence building discourse that emerged from the group discussions was the discourse that draws more explicitly on transversal competences. We have labelled this discourse a broad unifying discourse in building coherence. Rather than a mechanical combination of subjects, this discourse shows more clearly that the coherence and integration between subjects in multidisciplinary work is outlined explicitly in terms of the multidisciplinary theme, as opposed to the content or objectives of individual subjects, as illustrated by the following extract:

11) This is something that can be brought up in all subjects, for example in subjects like home economics and then in mathematics, so it's a really multidisciplinary topic. (GD1/21)

In the broad unifying discourse, multidisciplinary is conceived as a coherent and goal-oriented entity, in which the viewpoints of different subject areas offer their distinct perspective on the theme at hand (see extract 12). The disciplines are seen as intersecting in addressing the transversal theme (see extract 13) and the contribution of each subject is described as providing its own dimension to the transversal work, through which the common theme can unfold in an interesting and instructive way:

12) This would be a very interesting multidisciplinary learning module if the same topic was discussed from slightly different perspectives in different subjects. It could shed some light on it for the students in a very interesting way. (GD3/21)

13) How to get the students to activate their own thinking about what else could be done and what they could do themselves? And then what countries can do, what cities can do? There are links to quite many subjects here, but I think that these things can be dealt with in foreign language classes as well. When they are discussed in the target language, the pupils learn the language and vocabulary and at the same time they learn about this topic. Then if these important topics were addressed in every subject, it would become perhaps more self-evident to them. (GD3/21)

Finally, the broad unifying discourse also reflects the ethos of building multidisciplinary coherence, in which the integration of subjects (see extract 14, *tie them together more*) or a multidisciplinary joint project (see extract 15) can provide students with meaningful experiences and at the same time create the conditions for connecting the subject matter more explicitly to the surrounding society. In this way, multidisciplinary work also enables pupils to experience participation, which is considered one of the key cornerstones of multidisciplinary work (FNAE, 2014).

14) I also thought that if you tie them [=different subjects] together more, it can bring more the experience that it's really meaningful and do something useful and then on the other hand if you tie them together you might get more involved in the surrounding society. (GD3/21)

15) In social studies we want to encourage pupils to be active in society, so it's a good way to include the language so that they would start - somehow through participation and they could take part in an international project so that they could practice the language at the same time and then it would be a kind of joint project. (GD3/21)

One feature of the broad unifying discourse is that, in it, the objectives for multidisciplinary work that are common to all subjects are described. In this discourse, when describing multidisciplinary work, perspectives that unite the subjects and

build coherence are sought from broader unifying agendas regardless of the subject. For example, in addressing climate change, pupils are guided to understand that there is potential and hope for action to solve problems such as sustainable development:

16) Something that I think is perhaps important in all subjects is that there is hope that we can do something about this and that we can have an impact, and somehow I would see this as something that unites all the subjects. (GD1/21)

7.6.3 The Holistic Discourse of Change

The third coherence-building discourse in our data is the holistic discourse of change. This differs from the discourses above in that it describes disciplinary coherence in multidisciplinary work as an ideal for the future and a kind of change that is still to come.

From the perspective of building coherence, the holistic discourse of change can be seen as a kind of counter-discourse to the subject-based integration discourse, as within this discourse, students are sometimes very clear in their criticism of the fact that subjects have been kept so separate (see extract 17) and subject boundaries have been too closed (see extract 18). At the same time, this discourse reflects a desire for change, which shows that students have an embedded ideal of multidisciplinary work and the teaching of broad learning units (see transversal competences in the curriculum, FNAE, 2014), specifically as a non-subject-oriented pedagogical activity.

17) I feel that the subjects have been kept so separate that it's high time to change it a bit. (GD3/21)

18) More active demonstration that something can really be done and that this works. I'm thinking a bit more broadly than from the viewpoint of language teaching, but then if I think about my own English teaching, the language is always a good element in it, but somehow I would like to take ways from other subjects as well and not to have such closed boundaries when it comes to such broad learning modules. (GD3/21)

Although the above quotes reflect the holistic discourse of change, the students are still relatively moderate in their views, which is reflected in their choice of words (e.g., “a bit” in extracts 17 and 18 and “ways” in extract 18).

The holistic discourse of change can be seen as reflecting the ideal put forward by the curricula of multidisciplinary work as a long-term and pervasive approach, as illustrated by extract 19:

19) It would be kind of ideal that maybe I also like things to be constantly in the background to some extent that they are addressed in a slightly broader context than just that we had a theme day and now it's over and it was about climate change this year. (GD2/21)

The above example brings to the fore a mild criticism that multidisciplinary work is easily reduced to a single theme day instead of relating it to a broader context. The fact that the discourse seems to reflect the ideal of the curricula and to indicate only a possible future direction is reflected throughout in the conditional forms (e.g., *would*) which are very typical of this discourse.

This discourse clearly shows how students have been socialized to understand the basic principles of multidisciplinary work, through which a coherence regarding linking subjects is also built in this discourse. Extract 20 illustrates that students describe multidisciplinary work as a long-term activity, ideally as an organic part of teaching that is sufficiently long-lasting (see also the curriculum, FNAE, 2014), preferably the entire academic year:

20) It's a good point that a theme day can be just fine but it would be more important to try to make it an organic part of the teaching so that it would be present throughout the school year to make people think and also try to provide up-to-date information and to justify things with facts. (GD2/21)

Through the holistic discourse of change, multidisciplinary work is described as cooperation between teachers, based on a common set of values and common guidelines through which the unification of teaching is seen as possible. Coherence in multidisciplinary work is then built through a jointly constructed broader pedagogical understanding and by taking into account the understanding of the same theme built up by other subjects in the teaching of individual subjects. It is clear that this kind of pedagogical work requires strong pedagogical collaboration, as the following extract illustrates:

21) We would all be in favor of such cooperation that we could take things from the methods of other subjects and from the things that are going on there about the same topic and make it a bit more uniform so that one teacher doesn't say one thing and another one says another but that they would be in accordance with the values of the curriculum and the school. Then more broadly for the guidelines to be clear, it would need this kind of cooperation between teachers in the school and a common view in

a particular school so that these things could be taken forward pedagogically. (GD3/21)

In the holistic discourse of change, it is sometimes quite clearly expressed that genuinely multidisciplinary work that brings subjects together is seen as desirable and valued, which is typically reflected in various evaluative expressions (*great, useful, meaningful*; see extracts 14 and 22). From the viewpoint of building coherence, however, multidisciplinary cooperation is sometimes described as something for which there are still practical obstacles in today's school, such as a lack of resources:

22) I think it would be great if there were some schools with the resources to be able to combine, for example, religion, history and social studies so you would get a really great multidisciplinary module, for example, from the perspective of climate change combined with for example foreign languages, geography, biology... just about any subject really. (GD3/21)

7.7 Discussion & Conclusion

This article examined the participants' perceptions of disciplinary coherence in group discussions organized in a course focusing on multidisciplinary. The findings imply that the students had different attitudes towards disciplinary coherence. Most of them approached it in a rather mechanical way through their own subject, resembling the ethos of multidisciplinary learning (Choi & Pak, 2006; Drake & Burns, 2004; Klein, 2010), which is strongly underpinning Finnish education. Others, in turn, expressed views that approached disciplinary coherence in more depth and even linked it to interdisciplinary and transdisciplinary approaches (Choi & Pak, 2006; Drake & Burns, 2004; Klein, 2010). However, they too did not seem to perceive the disciplinary and multidisciplinary approaches as a dichotomy, but rather as a meaningful combination of both. On the other hand, as future subject teachers, they were clearly oriented towards the clash between the ideal of multidisciplinary teaching and the practical realities. Even if teachers are motivated and willing to implement multidisciplinary learning through co-teaching, the current school culture and teaching resources do not necessarily support this.

Many factors may influence the participants' attitudes towards multidisciplinary. Firstly, the organization of their studies and their entire subject didactics

part can easily lead them to analyze things by default mainly from the viewpoint of their own subject. This orientation may have been influenced by the way in which the students have been guided to understand the importance of multidisciplinary in subject teaching. It is possible that there has not been a clear and coherent view on this among the teacher educators either. In the future, the program could be developed in a way so that the importance and modelling of multidisciplinary teaching and the links between different subjects in multidisciplinary work are made more explicitly visible. Additionally, the fact that the participants are future subject teachers and not primary school teachers may be an argument in favor of a more subject-oriented approach. The participants mainly study a single subject and its didactics, which is naturally more important in their pedagogical thinking than for primary teachers, who have to master a broader range of subjects. As a result, primary teachers are presumably more likely to combine subjects and seek links between them.

The age of the pupils may also be a factor. Subject teachers typically work with older pupils than primary school teachers. Multidisciplinary is often approached in greater depth with younger pupils, while more subject-specific issues are explored with older pupils. For example, the International Baccalaureate curriculum follows an inquiry-based, transdisciplinary curriculum framework in primary school, whereas at the secondary level, the approach is more interdisciplinary and disciplinary (International Baccalaureate, n.d.). Similarly, in Finnish upper secondary schools, the tendency is more towards a disciplinary rather than multidisciplinary approach, although the latest curriculum has introduced 6 transversal competences encouraging more multidisciplinary learning. However, the matriculation examinations at the end of upper secondary school do fairly little to reflect multidisciplinary. Although from 2023 onwards, they will also include multidisciplinary tasks that can build on the transversal competences introduced in the curriculum. It will therefore be interesting to see how the development of multidisciplinary will progress in upper secondary schools and matriculation examinations and what kind of washback effect (see e.g., Kuang, 2020) it may have on teaching. Multidisciplinary is therefore clearly an aspect that will be emphasized in the future and which must also be taken into account more clearly in teacher education. Even if the degree of multidisciplinary defined in the curricula can be perceived as quite moderate compared to a transdisciplinary learning approach, it seems imperative to address the topic with future teachers in a deep and profound way, as it has not yet taken root very strongly in the field (e.g., Venäläinen et al., 2020).

Some students challenged or questioned certain fixed traditions and practices related to school and teaching. Questioning subject orientation was one example, and some expressed the view that strict boundaries between subjects should be abandoned (see also Cantell, 2017). Participants also highlighted the importance of collaboration in achieving the ideal of multidisciplinary. Rather than just physical co-teaching, they emphasized more the shared values and views on pedagogy that each teacher can implement and convey in their own teaching. As Juuti et al. (2015) also emphasize, teachers can implement multidisciplinary teaching on their own by incorporating interdisciplinary content, perspectives and methods in their teaching. This could be assumed to be relatively natural, as many of the disciplines themselves are already inherently interdisciplinary.

Multidisciplinary learning has been presented as a solution or alternative to strong textbook-based teaching (Kujamäki, 2014), which is very strong in Finland in all subjects (e.g., Hiidenmaa et al., 2017). The students' quotes also reflected a vision of implementing multidisciplinary teaching in ways other than using textbooks. As working methods, multidisciplinary learning is often associated with phenomenon-based learning, which has been implemented in many Finnish schools (e.g., Symeonidis & Schwarz, 2016), as well as inquiry-based learning (Pedaste et al., 2015). These were implicitly referred to in the group discussions. However, none of the students challenged another feature of traditional schooling, namely, learning in age-structured groups. In some schools, it is precisely multidisciplinary learning modules that have been implemented across grade levels (see e.g., Tarnanen et al., 2019).

Overall, the participants seemed to be searching for a meaningful balance between a subject-oriented and multidisciplinary approach to teaching. This balancing act can also be observed in the curricula which try to marry disciplinary and multidisciplinary learning in a coherent way. What is then the ideal level of multidisciplinary in teaching? Does a subject-based approach have its place at school as the main approach to learning or should there be a shift towards stronger multidisciplinary learning? How can we achieve a meaningful and appropriate approach between the two and how can the right balance ever be found for every situation and every individual? In the future, these issues will certainly be increasingly considered by curriculum developers, teacher educators and individual teachers alike. In order for us teacher educators to be able to guide future teachers in taking account of multidisciplinary, we ourselves must first be aware of its complexity and related dimensions. The question we must ask ourselves is what kind of disciplinary coherence are we aiming for and what challenges or gaps might such coherence bring with it.

References

- Aarnio-Linnanvuori, E. (2018). *Ympäristö ylittää oppiainerajat: Arvolatautuneisuus ja monialaisuus koulun ympäristöopetuksen haasteina*. University of Helsinki.
- Alvargonzález, D. (2011). Multidisciplinarity, interdisciplinarity, transdisciplinarity, and the sciences. *International Studies in the Philosophy of Science*, 25(4), 387–403.
- Boning, K. (2007). Coherence in general education: A historical look. *The Journal of General Education*, 56(1), 1–16.
- Brand, B. R., & Triplett, C. F. (2012). Interdisciplinary curriculum: An abandoned concept? *Teachers and Teaching: Theory and Practice*, 18(3), 381–393.
- Broad, K., Stewart Rose, L., Lopez, A. E., & Baxan, V. (2013). Coherence as a verb: Reconceptualizing coherence in teacher education. In L. Thomas (Ed.), *What is Canadian about teacher education in Canada?* (pp. 234–258). Jossey Bass.
- Canrinus, E. T., Klette, K., & Hammerness, K. (2019). Diversity in coherence: Strengths and opportunities of three programs. *Journal of Teacher Education*, 70(3), 192–205.
- Cantell, H. (2017). Monialaisuuden haasteita ja mahdollisuuksia opettamisessa ja oppimisessa. In A. Toom, M. Rautiainen, & J. Tähtinen (Eds.), *Toiveet ja todellisuus—kasvatus osallisuutta ja oppimista rakentamassa* (pp. 225–252). FERA.
- Choi, B. C. K., & Pak, A. W. P. (2006). Multidisciplinarity, interdisciplinarity and transdisciplinarity in health research, services, education and policy: 1. Definitions, objectives, and evidence of effectiveness. *Clinical and Investigative Medicine*, 29, 351–364.
- Coleman, H., Boit, R., Butterworth, L., La Paro, K., Ricks, T., Hestenes, L., Ozdemir, M., & Aal-Anubia, A. J. (2023). Effective teaching strategies: Pre-service teachers' experiences in team taught courses in an interdisciplinary Early Childhood teacher education program. *Teaching and Teacher Education*, 121, 103937.
- Darling-Hammond, L., Burns, D., Campbell, C., Goodwin, A. L., Hammerness, K., Low, E. L., ... Zeichner, K. (2017). *Empowered educators: How high-performing systems shape teaching quality around the world*. Jossey-Bass.
- Drake, S. M., & Burns, R. C. (2004). *Meeting standards through integrated curriculum*. ASCD.
- Fairclough, N. (1992). Discourse and text: Linguistic and intertextual analysis within discourse analysis. *Discourse & Society*, 3(2), 193–217.
- Faulconer, E. K., Wood, B., & Griffith, J. C. (2020). Infusing humanities in STEM education: Student opinions of disciplinary connections in an introductory chemistry course. *Journal of Science Education and Technology*, 29, 340–345.
- Finnish National Core Curriculum for Basic Education (FNCCBE). (2014). Finnish National Board of Education.
- Finnish National Core Curriculum for General Upper Secondary Education (FNCCGUSE). (2019). Finnish National Board of Education.
- Fitzgerald, S. L., Popa, C., Fitzgerald, C., & Vesa, A. (2021). Interdisciplinary Learning for Pre-service Teachers. *Revista Romaneasca pentru Educatie Multidimensionala*, 13(1Sup1), 101–122.

- Geiger, V., Mulligan, J., Date-Huxtable, L., Ahlip, R., Jones, D. H., May, E. J., Rylands, L., & Wright, I. (2018). An interdisciplinary approach to designing online learning: Fostering pre-service mathematics teachers' capabilities in mathematical modelling. *ZDM*, 50, 217–232.
- Gentzler, E. (2003). Interdisciplinary connections. *Perspectives: Studies in Translatology*, 11(1), 11–24.
- Grossman, P., Hammerness, K. M., McDonald, M., & Ronfeldt, M. (2008). Constructing coherence: Structural predictors of perceptions of coherence in NYC teacher education programs. *Journal of Teacher Education*, 4, 273–287.
- Hammerness, K. (2006). From coherence in theory to coherence in practice. *Teachers College Record*, 108(7), 1241–1265.
- Harju-Autti, R., Saarnio, M., Hanska, J., & Lahti, L. (2021). Oppiainerajoja rikkomassa: Opiskelijoiden kokemuksia oppiainerajat ylittävästä yhteistyöstä aineenopettajakoulutuksessa. In E. Luukka, A. Palomäki, L. Pihkala-Posti, & J. Hanska (Eds.), *Opetuksen ja oppimisen ytimessä* (pp. 194–221). Suomen ainedidaktinen tutkimusseura.
- He, A. W. (2017). Discourse analysis. In M. Aronoff & J. Rees-Miller (Eds.), *The Handbook of linguistics* (pp. 445–462). Wiley.
- Hiidenmaa, P., Löytynen, M., & Ruuska, H. (Eds.). (2017). *Oppikirja Suomea rakentamassa*. Suomen Tietokirjailijat ry.
- International Baccalaureate. (n.d.). International Baccalaureate. Retrieved February 21, 2023 from <https://www.ibo.org/>
- Juez, L. A. (2009). *Perspectives on discourse analysis: Theory and practice*. Cambridge Scholars Publishing.
- Juuti, K., Kairavuori, S., & Tani, S. (2015). Tiedonalalähtöinen eheyttäminen. In H. Cantell (Ed.), *Näin rakennat monialaisia oppimiskokonaisuuksia* (pp. 77–93). PS-kustannus.
- Kallioniemi, A., & Virta, A. (2012). Ainedidaktiikka tutkimuskenttänä. In A. Kallioniemi & A. Virta (Eds.), *Ainedidaktiikka tutkimuskohteena ja tiedonalana* (pp. 9–15). FERA.
- Klein, J. T. (2010). A taxonomy of interdisciplinarity. In R. Frodeman (Ed.), *The Oxford handbook of interdisciplinarity* (pp. 15–30). Oxford University Press.
- Kuang, Q. (2020). A review of the washback of English language tests on classroom teaching. *English Language Teaching*, 13(9), 10–17.
- Kujanmäki, P. (2014). *Yhteisenä tavoitteena opetuksen eheyttäminen*. University of Eastern Finland.
- Lehtonen, A., Salonen, A., Cantell, H., & Riittanen, L. (2018). A pedagogy of interconnect-edness for encountering climate change as a wicked sustainability problem. *Journal of Cleaner Production*, 199, 860–867.
- Mezirow, J. (2006). An overview of transformative learning. In P. Sutherland & J. Crowther (Eds.), *Lifelong learning* (pp. 24–38). Routledge.
- Pedaste, M., Mäeots, M., Siiman, L. A., de Jong, T., van Riesen, S. A. N., Kamp, E. T., Manoli, C. C., Zacharia, Z. C., & Tsourlidaki, E. (2015). Phases of inquiry-based learning: Definitions and the inquiry cycle. *Educational Research Review*, 14, 47–61.
- Richmond, G., Bartell, T., Carter Andrews, D. J., & Neville, M. L. (2019). Reexamining coherence in teacher education. *Journal of Teacher Education*, 70(3), 188–191.
- Symeonidis, V., & Schwarz, J. F. (2016). Phenomenon-based teaching and learning through the pedagogical lenses of phenomenology: The recent curriculum reform in Finland. *Forum Osviatowe*, 28(2), 31–47.

- Tanase, M. F., & Lucey, T. A. (2017). Pre-service teachers' awareness of interdisciplinary connections: Mathematics, financial literacy, and social justice issues. *Investigations in Mathematics Learning*, 9(1), 2–18.
- Tarnanen, M. J., Kaukonen, V., Kostiaainen, E., & Toikka, T. (2019). Mitä opin? Monilukutaitoa ja tutkivaa oppimista monialaisessa oppimiskokonaisuudessa. *Ainedidaktikka*, 3(2), 24–46.
- Tatto, M. (1996). Examining values and beliefs about teaching diverse students: Understanding the challenges for teacher education. *Educational Evaluation and Policy Analysis*, 18, 155–180.
- Venäläinen, S., Saarinen, J., Johnson, P., Cantell, H., Jakobsson, G., Koivisto, P., Routti, M., Väänänen, J., Huhtanen, M., Kauppinen, L., & Viitala, M. (2020). *Näkymiä OPS-matkan varrelta: Esi- ja perusopetuksen opetussuunnitelmien perusteiden 2014 toimeenpanon arviointi*. Finnish Education Evaluation Centre.

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